Final

Phase I RFI/RI Work Plan

Rocky Flats Plant
Inside Building Closures
(Operable Unit 15)

U.S. Department of Energy
Rocky Flats Plant
Golden, Colorado

Environmental Restoration Program

October 1992

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Draft

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Approved by:

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Manager, Remediation Programs — RFI Project Manager

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AEC	Atomic Energy Commission
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
BRAP	Baseline Risk Assessment Plan
CAD	Corrective Action Decision
CDH	Colorado Department of Health
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
COC	contaminants of concern
CRP	Community Relations Plan
CWA	Clean Water Act
DCN	Document Change Notice
DMC	derived media concentration
DOE	U.S. Department of Energy
DRCOG	Denver Regional Council of Governments
DQO	data quality objective
EEWP	Environmental Evaluation Work Plan
EE	Environmental Evaluation
EM	Environmental Management
EMD	Environmental Management Division
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
FR	Federal Register
FS	feasibility study
FSP	Field Sampling Plan
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
HEPA	High Efficiency Particulate Air (filter)
HEAST	Health Effects Assessment Summary Tables

HPGD	high purity germanium detector
HSL	hazardous substance list
HSP	Health and Safety Plan
HSL	hazardous substance list
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
IPPCD	Interim Plan for Prevention of Contaminant Dispersion
IRIS	Integrated Risk Information System
MCL	maximum contaminant level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OP	Operating Procedure
OU	operable unit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PQL	practical quantitation limit
PRP	potentially responsible party
QAA	Quality Assurance Addendum
QA/QC	quality assurance/quality control
QAPjP	Quality Assurance Project Plan
RAS	routine analytical service
RCRA	Resource Conservation and Recovery Act
RfD	risk reference dose
RFEDS	Rocky Flats Environmental Database System
RFI	RCRA Facility Investigation
RFP	Rocky Flats Plant
RI	remedial investigation (CERCLA)
RME	reasonable maximum exposure
ROD	Record of Decision
RSP	respirable suspended particulate
SAS	special analytical services
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986

SDWA	Safe Drinking Water Act
SSH&SP	Site Specific Health and Safety Plan
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to be considered
TCA	trichloroethane
TCL	Target Compound List
TIC	tentatively identified compound
UCNI	uncontrolled classified nuclear information
VOC	volatile organic compound
WQC	Water Quality Criteria
WQCC	Water Quality Control Commission
WSIC	Waste Stream Identification and Characterization

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Manager, Remediation Programs RFI Project Manager

EXECUTIVE SUMMARY

This document presents the work plan for the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI) for Operable Unit 15 (OU15) - Inside Building Closures, at the Rocky Flats Plant (RFP) in Jefferson County, Colorado. OU15 consists of six RCRA-regulated interim status closure units all located within buildings at RFP.

The RFI/RI is pursuant to the RFP Interagency Agreement (IAG) with the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH) dated January 22, 1991 (U.S. DOE, 1991a).

As required by the IAG, this Phase I work plan addresses characterization of the nature and extent of potential contamination associated with the Individual Hazardous Substance Sites (IHSSs) comprising OU15. The six IHSSs comprising OU15 are interim status RCRA units. In accordance with the IAG, the results of the Phase I RFI/RI will determine the need for further action and closure alternatives at IHSSs within OU15. OU15 includes the following IHSSs:

IHSS 178	Building 881, Drum Storage Area (Room 165)
IHSS 179	Building 865, Drum Storage Area (Room 145)
IHSS 180	Building 883, Drum Storage Area (Room 104)
IHSS 204	Unit 45, Original Uranium Chip Roaster (Building 447, Rooms 31, 32, 501, and 502)
IHSS 211	Unit 26, Building 881, Drum Storage Area (Room 266B)
IHSS 217	Unit 32, Cyanide Bench Scale Treatment (Building 881, Room 131C)

IHSSs 212 and 215 were originally included in OU15 in accordance with the IAG. However, based on a recent agreement with IAG members, these IHSSs are no longer included in OU15. IHSS 212 is an operational interim status RCRA drum storage area included in the 1988 RCRA Part B Permit Application. Therefore, this unit will not be included in the OU15 RFI/RI. IHSS 215 is an out-of-service tank (Tank T-40), which has already been included in the Phase I RFI/RI for the Original Process Waste Lines - OU9. The IAG shall be amended to reflect these changes to OU15.

The initial step in development of the OU15 work plan was a review of existing information. Available historical and background data were collected through a literature search and a review of the Rocky Flats Environmental Database System (RFEDS). This information was used in characterizing the physical setting, site physical features (including relevant construction and containment information), and known or suspected contamination associated with OU15. This information was then used to develop a conceptual model for the IHSSs within OU15.

Based primarily on guidance provided by CDH and EPA regarding the scope of the Field Sampling Plan (FSP) and the site characterization, data quality objectives (DQOs) have been developed for the OU15 Phase I RFI/RI. DQOs are qualitative and quantitative statements that describe the quality and quantity of data required by the RFI/RI. [In accordance with guidance provided by the regulatory agencies during scoping meetings for OU15, the FSP for OU15 is essentially identical to the stie characterization activities proposed in the closure plans for the IHSSs in order to eliminate duplication of effort.] Through application of the DQO process, site-specific Phase I RFI/RI goals are established and data needs are identified for achieving these goals.

In accordance with the IAG, the objective of the Phase I RFI/RI for OU15 is to characterize the nature and extent of potential contamination associated with the IHSSs within OU15 and determine the need for further action including closure alternatives. Within this broad objective, site-specific goals and data needs have been identified for the Phase I RFI/RI for OU15. The FSP presented in this work plan is designed to generate the data needed to meet the site-specific goals. Based on the amount and reliability of existing information, the sampling/analysis activities specified in the FSP for each IHSS within OU15 include document/literature review, site surveys, screening activities, sampling and analysis of drummed wastes (if present), and swipe sampling and analysis of IHSS surfaces.

Data collected during the OU15 Phase I RFI/RI will be incorporated into the existing RFEDS data base. These data will be used to (1) characterize the nature and extent of environmental contamination at, or resulting from, OU15 IHSSs; (2) determine whether releases have occurred at the IHSSs; (3) support the baseline risk assessment and closure activities; and (4) determine the need for further action at OU15. An RFI/RI report will be prepared to summarize the data obtained during the Phase I program. The RFI/RI report will also include the Phase I Baseline Risk Assessment for those IHSSs where residual contamination has been identified. The Baseline Risk Assessment will include a Human Health Risk Assessment and an Environmental Evaluation (EE). However, the EE for OU15 will be based on information provided by the EE for OU9. An Environmental Evaluation (EE) will not be performed for OU15 because OU15 IHSSs are all located within buildings that lie entirely within the industrialized areas of the Rocky Flats Plant and because the EE for OU9 includes the OU15 area.

Approved by:

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Manager, Remediation Programs RFI Project Manager

1.0 INTRODUCTION

This document presents the work plan for the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI) for Operable Unit 15 (OU15) at the Rocky Flats Plant (RFP) in Jefferson County, Colorado.

This investigation is part of a comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions currently in progress at RFP. These investigations are pursuant to the RFP an Interagency Agreement (IAG) signed by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH) dated January 22, 1991 (U.S. DOE, 1991a). The IAG program developed by DOE, EPA, and CDH addresses RCRA and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations applicable to remedial investigations at OU15. In accordance with the IAG, the term "Individual Hazardous Substance Site" (IHSS) is equivalent to the term "Solid Waste Management Unit" (SWMU). Also in accordance with the IAG, the CERCLA terms "remedial investigation" and "feasibility study" as used in this document are considered equivalent to the RCRA terms "RCRA Facility Investigation" and "Corrective Measures Study" (CMS), respectively.

As required by the IAG, this Phase I work plan addresses characterization of the nature and extent of contamination associated with the IHSSs comprising OU15. Information presented in the RFI/RI report will be used to (1) characterize the nature and extent of contamination associated with OU15 IHSSs; (2) determine whether releases have occurred; (3) support the baseline risk assessment and closure activities; and (4) determine the need for further action.

The following IHSSs are included within OU15:

IHSS 178	Building 881, Drum Storage Area (Room 165)
IHSS 179	Building 865, Drum Storage Area (Room 145)
IHSS 180	Building 883, Drum Storage Area (Room 104)
IHSS 204	Unit 45, Original Uranium Chip Roaster (Building 447, Rooms 31, 32, 501, and 502)
IHSS 211	Unit 26, Building 881, Drum Storage Area (Room 266B)
IHSS 217	Unit 32, Cyanide Bench Scale Treatment (Building 881, Room 131C)

IHSSs 212 and 215 were originally included in OU15 in accordance with the IAG (U.S. DOE, 1991a). However, based on a recent agreement between the IAG members, these IHSSs will not be included in OU15. IHSS 212 is an operational interim status RCRA drum storage area (Unit 63) located in Room 3420 of Building 371. Because this unit is currently operational and included in the 1988 RCRA Part B Permit Application submitted to CDH on July 1, 1988, for storage of transuranic mixed waste, it will not be included in OU15 for investigation. IHSS 215 is an out-of-service 7,200 gallon concrete tank (Tank T-40) located in Building 774. This IHSS has been included in the Phase I RFI/RI Work Plan for the Original Process Waste Lines - Operable Unit 9 (OU9) (U.S. DOE, 1992a) which is scheduled to be implemented in July 1992.

In this work plan, the existing information is summarized, data gaps are identified, data quality objectives (DQOs) are established, and a Field Sampling Plan (FSP) is presented to characterize site physical features, define sources of contamination, evaluate potential release pathways within the buildings to the environment, and determine the nature and extent of contamination associated with OU15 IHSSs and the need for further action.

The Phase I RFI/RI will be conducted in accordance with the *Interim Final RCRA Facility Investigation (RFI) Guidance* (U.S. EPA, 1989a), *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA, 1988a), and all other applicable documents referenced in the IAG.

1.1 ENVIRONMENTAL RESTORATION PROGRAM

The Environmental Restoration (ER) Program, designed for investigation and cleanup of environmentally contaminated sites at DOE facilities, is being implemented in five phases. Phase 1 (Installation Assessment) includes preliminary assessments and site inspections to assess potential environmental concerns. Phase 2 (Remedial Investigations) includes planning and implementation of sampling programs to delineate the magnitude and extent of contamination at specific sites and evaluate potential contaminant migration pathways. Phase 3 (Feasibility Studies) includes evaluation of remedial alternatives and development of remedial action plans to mitigate environmental problems identified in Phase 2 as needing correction. Phase 4 (Remedial Design/Remedial Action) includes design and implementation of site-specific remedial actions selected on the basis of Phase 3 feasibility studies. Phase 5 (Compliance and Verification) includes monitoring and performance assessments of remedial actions as well as verification and documentation of the adequacy of remedial actions carried out under Phase 4. Phase 1 has been completed at RFP (U.S. DOE, 1986a), and Phase 2 is currently in progress for OU15.

1.2 WORK PLAN OVERVIEW

This work plan presents an evaluation and summary of previous data and investigations, defines DQOs and data needs based on that evaluation, specifies Phase I RFI/RI tasks, and presents the FSP for the Phase I RFI/RI.

Section 2.0 (Site Characterization) presents a comprehensive review and detailed analysis of all available historical information, previous site investigations, recently published reports, available data, and past and present activities pertinent to OU15. Included in Section 2.0 are descriptions of the operational histories of the units, types of wastes stored/treated, and relevant site physical features, including information on the unit size, design/construction, inventory, and containment and monitoring systems. Characterization results for site geology and hydrology pertinent to the environmental setting of OU15 are also presented in this section. Additionally, Section 2.0 presents conceptual models for the units based on the physical characteristics of the IHSS, potential or known release pathways, and available information regarding the nature and extent of contamination known or potentially associated with each IHSS within OU15. Section 3.0 presents a preliminary identifiation of potential chemical-specific Benchmarks for ground water and surface water at RFP and a discussion of their application to the RFI/RI activities at OU15. Section 4.0 discusses the DQOs and work plan rationale for the Phase I RFI/RI. Section 5.0 specifies tasks to be performed for the Phase I RFI/RI. The schedule for performance of Phase I RFI/RI activities is presented in Section 6.0. Section 7.0 presents the FSP to meet the objectives presented in Section 4.0. The Baseline Human Health Risk Assessment Plan is discussed in Section 8.0. The scope of the Environmental Evaluation Work Plan (EEWP) as it relates to OU15 and the industrial portion of RFP is discussed in Section 9.0. The site-specific Quality Assurance Addendum (QAA) for OU15 is discussed in Section 10.0. Section 11.0 presents the standard Operating Procedures (OPs) and Document Change Notices (DCNs) for performing the fieldwork so that DQOs for the Phase I RFI/RI are met.

The appendices contain the available unclassified controlled nuclear information (UCNI) used to characterize the physical features of the OU15 IHSSs.

1.3 REGIONAL AND PLANT SITE BACKGROUND INFORMATION

1.3.1 Facility Background and Plant Operations

RFP is a government-owned, contractor-operated facility, which is part of the nationwide Nuclear Weapons Complex. The plant was operated for the U.S. Atomic Energy Commission (AEC) from its inception in 1951 until the AEC was dissolved in January 1975. At that time, responsibility for the plant was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977. Dow Chemical U.S.A., an operating unit of the Dow Chemical Company, was the prime operating contractor of the facility from 1951 until June 30, 1975. Rockwell International was the prime contractor responsible for operating RFP from July 1, 1975, until December 31, 1989. EG&G Rocky Flats, Inc. became the prime contractor at RFP on January 1, 1990.

Operations at RFP consisted of fabrication of nuclear weapons components from plutonium, uranium, and other nonradioactive metals (principally beryllium and stainless steel). Parts made at the plant are shipped elsewhere for assembly. In addition, the plant reprocesses components after they are removed from obsolete weapons for recovery of plutonium. Other activities at RFP include research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. Both radioactive and nonradioactive wastes are generated in the production process. Current waste handling practices involve onsite and offsite recycling of hazardous materials, onsite storage of hazardous and low-level radioactive mixed wastes, and offsite disposal of solid low-level radioactive materials at appropriate DOE facilities. However, RFP operating procedures have historically included both onsite storage and disposal of hazardous, low-level radioactive, and low-level radioactive mixed wastes. Preliminary assessments under the Environmental Management (EM) Program identified some of the past onsite storage and disposal locations as potential sources of environmental contamination.

1.3.2 Previous Investigations

Various studies have been conducted at RFP to characterize environmental media and to assess the extent of radiological and chemical contaminant releases to the environment. The investigations performed prior to 1986 were summarized by Rockwell International (1986a) and include the following:

1. Detailed description of the regional geology (Malde, 1955; Spencer, 1961; Scott, 1960, 1963, 1970, 1972, and 1975; Van Horn, 1972 and 1976; Dames and Moore, 1981; and Robson et al., 1981a and 1981b)

2. Several drilling programs beginning in 1960 that resulted in construction of approximately 60 monitoring wells by 1982

3. An investigation of surface water and ground water flow systems by the U.S. Geological Survey (Hurr, 1976)

4. Environmental, ecological, and public health studies that culminated in an Environmental Impact Statement (U.S. DOE, 1980)

5. A summary report on ground water hydrology using data from 1960 to 1985 (Hydro-Search, Inc., 1985)

6. A preliminary electromagnetic survey of the plant perimeter (Hydro-Search, Inc, 1986)

7. A soil-gas survey of the plant perimeter and buffer zone (Tracer Research, Inc., 1986)

8. Routine environmental monitoring programs addressing air, surface water, ground water, and soils (Rockwell International, 1975 through 1985, and 1986b)

In 1986, two major investigations were completed at the plant. The first was the DOE Comprehensive Environmental Assessment and Response Program (CEARP) Phase 1 Installation Assessment (U.S. DOE, 1986a), which included analyses and identification of current operational activities, active and inactive waste sites, current and past waste management practices, and potential environmental pathways through which contaminants could be transported. A number of sites that could potentially have adverse impacts on the environment were identified. These sites were designated as SWMUs by Rockwell International (1987a). In accordance with the IAG, SWMUs are now designated as IHSSs, which are divided into three categories:

1. Hazardous waste substance sites that will continue to operate and need a RCRA operating permit

2. Hazardous waste substance sites that will be closed under RCRA interim status

3. Inactive waste substance sites that will be investigated and cleaned up under Section 3004(u) of RCRA or pertinent sections of CERCLA and SARA

The second major investigation completed at the plant in 1986 involved a hydrogeologic and hydrochemical characterization of the entire plant site. Plans for this study were presented by Rockwell International (1986c and 1986d), and study results were reported by Rockwell International (1986e).

1.3.3 Physical Setting

1.3.3.1 Location

RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 1-1). Other surrounding cities include Boulder, Westminster, Broomfield, and Arvada, all of which are located less than 10 miles to the northwest, east, and southeast, respectively. The plant consists of approximately 6,550 acres of federal land in Sections 1 through 4 and 9 through 15 of T2S, R70W, 6th Principal Meridian. Major buildings are located within the primary RFP site of approximately 400 acres. RFP is surrounded by a buffer zone of approximately 6,150 acres.

The plant is bounded on the north by State Highway 128, on the east by Jefferson County Highway 17, (also known as Indiana Street), on the south by agricultural and industrial properties and Highway 72, and on the west by State Highway 93 (Figure 1-1).

1.3.3.2 Topography

RFP is located along the eastern edge of the southern Rocky Mountain region immediately east of the Colorado Front Range. Quaternary alluvial gravels cap pediment surfaces of several distinct ages. The plant site is located on a broad eastward-sloping pediment that is capped by a 10- to 20-foot thickness of Rocky Flats Alluvium. The gently sloping alluvial fan has its apex at the mouth of Coal Creek west of RFP and its distal margins approximately 2 miles east of RFP. The tops of alluvial covered pediments are nearly flat-lying but slope eastward at 140 to 50 feet per mile (EG&G, 1992). At RFP the pediment capped by Rocky Flats Alluvium slopes approximately 70 feet per mile and is dissected by a series of east-northeast trending stream-cut valleys. The bases of the valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek lie 50 to 200 feet below the elevation of the older pediment surface. These valleys are incised into the bedrock underlying alluvial deposits, but most bedrock is concealed beneath colluvial material accumulated along the gentle valley slopes.

1.3.3.3 Meteorology

The area surrounding RFP has a semiarid climate characteristic of much of the central Rocky Mountain region. Based on precipitation averages recorded between 1953 and 1976, the mean annual precipitation at the plant is 15 inches. Approximately 40 percent of the precipitation falls during the spring season, much of it as wet snow. Thunderstorms (June to August) account for an additional 30 percent of the annual precipitation. Autumn and winter are drier seasons, accounting for 19 and 11 percent of the annual precipitation, respectively. Snowfall averages 85 inches per year, falling from October through May (U.S. DOE, 1980).

Winds at RFP, although variable, are predominantly from the west-northwest. Stronger winds occur during the winter, and the area occasionally experiences Chinook winds with gusts up to 100 miles per hour due to its location near the Front Range. The canyons along the Front Range tend to channel the air flow during both upslope and downslope conditions, especially when there is strong atmospheric stability (U.S. DOE, 1980).

Rocky Flats meteorology is strongly influenced by the diurnal cycle of mountain and valley breezes. Two dominant flow patterns exist, one during daytime conditions and one at night. During daytime hours, as the earth heats, air tends to flow toward the higher elevations (upslope). The general air flow pattern during upslope conditions for the Denver area is typically north to south, with flow moving up the South Platte River Valley and then entering the canyons into the Front Range. After sunset, the air against the mountain side is cooled and begins to flow toward the lower elevations (downslope). During downslope conditions, air flows down the canyons of the Front Range onto the plains.

Temperatures at RFP are moderate. Extremely warm or cold weather is usually of short duration. On average, daily summer temperatures range from 55 to 85 degrees Fahrenheit (°F), and winter temperatures range from 20 to 45 °F. Temperature extremes recorded at the plant range from 102 °F on July 12, 1971, to -26 °F on January 12, 1963. The 24-year daily average maximum temperature for the period 1952 to 1976 is 76 °F, the daily minimum is 22 °F, and the average mean is 50 °F. Average relative humidity is 46 percent (U.S. DOE, 1980).

1.3.3.4 Surface Water Hydrology

Three intermittent streams that flow generally from west to east drain RFP. These drainages are Rock Creek, Walnut Creek, and Woman Creek (Figure 1-1).

Rock Creek drains the northwestern corner of the buffer zone and flows northeastward through the buffer zone to its offsite confluence with Coal Creek. North and South Walnut Creeks and Dry Creek drain the northern portion of the plant complex. These three forks of Walnut Creek join in the buffer zone and flow to Great Western Reservoir approximately 1 mile east of the confluence. Flow is diverted around Great Western Reservoir into Big Dry Creek via the Broomfield Diversion Ditch. Rock Creek, North and South Walnut Creeks, and Dry Creek are intermittent streams. Flow occurs in these streams only after precipitation events and spring snowmelt. An east-west trending interfluve separates Walnut Creek from Woman Creek. Woman Creek, a perennial stream, drains the southern Rocky Flats buffer zone and flows eastward into Mower Reservoir. The South Interceptor Ditch is located between the plant and Woman Creek. The South Interceptor Ditch collects runoff from the southern portion of the plant complex and diverts it to Pond C-2, where it is monitored in accordance with the RFP National Pollutant Discharge Elimination System (NPDES) permit conditions.

1.3.3.5 Ecology

The industrialized area at RFP is highly developed for plant operations, and only small fragments of highly disturbed or landscaped habitat currently exist. These fragments are too small to support viable ecosystem functions. Wildlife, particularly birds, use artificial structures within the industrial area only transiently and obtain food and water almost exclusively outside this area.

A variety of vegetation is found within the buffer zone surrounding RFP. Included are species of flora representative of tall-grass prairie, short-grass plains, lower montane, and foothill ravine regions. Riparian vegetation exists along the site's drainages and wetlands. None of these vegetative species present at RFP have been reported to be on the endangered species list (EG&G, 1991a). Since acquisition of RFP property, vegetative recovery has occurred, as evidenced by the presence of disturbance-sensitive grass species such as big bluestem (*Andropogon gerardii*) and side oats grama (*Bouteloua curtipendula*). One vegetative species, Ute Ladies'-tresses (*Spiranthes diluvialis*), has been identified as a threatened species on the Threatened and Endangered Species list. The plants habitat has been identified as riparian areas of Colorado, specifically in riparian meadows in the City of Boulder, Boulder County and along Clear Creek in Jefferson County. RFP is located on a flat that divides two drainages feeding into Boulder County and Clear Creek. The plant has not been identified at RFP to date. No vegetative stresses attributable to hazardous waste contamination have been confirmed identified (U.S. DOE, 1980).

The fauna inhabiting the RFP and its buffer zone consists of species associated with western prairie regions. The most common large mammal is the mule deer (*Odocoileus hemionus*), with an estimated 100 to 125 permanent residents. There are a number of small carnivores, such as the coyote (*Canis latrans*), red fox (*Vulpes fulva*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*). Small herbivores can be found throughout the plant complex and buffer zone, including species such as the pocket gopher (*Thomomys* *talpoides*), white-tailed jackrabbit (*Lepus townsendii*), and the meadow vole (*Microtus pennsylvanicus*) (U.S. DOE, 1980).

Commonly observed birds include western meadowlarks (*Sturnella neglecta*), horned larks (*Eremophila alpestris*), mourning doves (*Zenaidura macroura*), and vesper sparrows (*Pooecetes gramineus*), western kingbirds (*Tyrannus vociferans*), black-billed magpies (*Pica pica*), American robins (*Turdus migratorius*), and yellow warblers (*Dendroica magnolia*). A variety of ducks, killdeer (*Charadrius vociferus*), and red-winged black birds (*Agelaius phoeniceus*) are seen in areas adjacent to ponds. Mallards (*Anas platyrhynochos*) and other ducks (*Anas sp.*) frequently nest and rear young on several of the ponds. Common birds of prey in the area include marsh hawks (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), ferruginous hawks (*Buteo regalis*), rough-legged hawks (*Buteo lagopus*), and great horned owls (*Bubo virginianus*) (U.S. DOE, 1980).

Bull snakes (*Pituophis melanoleucus*) and rattlesnakes (*Crotalus sp.*) are the most frequently observed reptiles. Eastern yellow-bellied racers (*Coluber constrictor flaviventris*) have also been seen. The eastern short-horned lizard (*Phrynosoma douglassi brevirostre*) has been reported on the site, but these and other lizards are not commonly observed. The western painted turtle (*Chrysemys picta*) and the western plains garter snake (*Thamnophis radix*) are found in and around many of the ponds (U.S. DOE, 1980).

Two procedures that concern identification and management of threatened and endangered species at RFP are currently being prepared by the EG&G National Environmental Policy Act (NEPA) Group. These are the draft *Identification and Reporting of Threatened and Endangered and Special Concern Species*, administrative procedure NEPA.12, Rev.0, and the draft *Protection of Threatened and Endangered and Special Concern Species*, OP FO.21, Rev.0.

1.3.3.6 Surrounding Land Use and Population Density

The population, economics, and land use of areas surrounding RFP are described in a 1989 Rocky Flats vicinity demographics report prepared by DOE (U.S. DOE, 1991b). This report divides general use of areas within 0 to 10 miles of RFP into residential, commercial, industrial, parks and open spaces, agricultural and vacant, and institutional classifications and considers current and future land use near the plant.

The majority of residential use within 5 miles of RFP is located immediately northeast, east, and southeast of RFP. The 1989 population distribution within areas up to 5 miles from RFP is illustrated in Figure 1-2. Commercial development is concentrated near residential developments north and southwest of Standley Lake as well as around Jefferson County Airport, approximately 3 miles northeast of RFP. Industrial land use within 5 miles of the plant is limited to quarrying and mining operations. Open space lands are located northeast of RFP near the City of Broomfield and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada. Standley Lake is surrounded by Standley Lake Park. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located northeast of RFP near the cities of Broomfield, Lafayette, and Louisville; north of RFP near Louisville and Boulder; and in scattered parcels adjacent to the eastern boundary of the plant. Several horse operations and small hay fields are located south of RFP. The demographic report characterizes much of the vacant land adjacent to RFP as rangeland (U.S. DOE, 1991b).

Future land use in the vicinity of RFP most likely involves continued urban expansion, increasing the density of residential, commercial, and perhaps industrial land use in the areas. The expected trend in population growth in the vicinity of RFP is also addressed in the DOE demographic study (U.S. DOE, 1991b). The report considers expected variations in population density by comparing the current (1989) setting to population projections for the years 2000 and 2010. A 21-year profile of projected population growth in the vicinity of RFP can thus be examined. DOE's projections are based primarily on long-term population projections developed by the Denver Regional Council of Governments (DRCOG). Expected population density and distribution around RFP for the years 2000 and 2010 are shown in Figures 1-3 and 1-4, respectively.

1.3.3.7 Regional Geology

RFP is located on a broad, eastward-sloping pediment surface along the western edge of the Denver Basin. The area is underlain by more than 10,000 feet of Pennsylvanian to Upper Cretaceous sedimentary rocks that have been folded and locally faulted. Along the foothills west of RFP, sedimentary strata are steeply east-dipping to overturned. West of the plant site, Upper Cretaceous sandstones of the Laramie Formation make up an east-dipping (45 to 55 degrees) hogback that strikes approximately north-northwest (Scott, 1960). Immediately west of the plant, steeply dipping sedimentary strata abruptly flatten to less than 2 degrees under and east of RFP (EG&G, 1991b). The sedimentary bedrock is unconformably overlain by Quaternary alluvial gravels that cap pediment surfaces of several distinct ages (Scott, 1965).

Figure 1-5 shows the local stratigraphic section for the Rocky Flats area. Upper Cretaceous bedrock units directly underlying RFP and pertinent to plant site hydrogeology include, in descending stratigraphic order, the Arapahoe Formation, the Laramie Formation, and the Fox Hills Sandstone. Bedrock units and the younger surficial geologic units at RFP are described below.

Rocky Flats Alluvium

The Rocky Flats Alluvium is the oldest and topographically highest alluvial deposit in RFP area. The Rocky Flats Alluvium is an alluvial fan deposit that occupies an extensive pediment surface sloping eastward from the mouth of Coal Creek Canyon. The thickness of the Rocky Flats Alluvium averages approximately 10 to 50 feet (Malde, 1955) but may be up to 100 feet thick in some locations. The thinnest deposits occur on top of bedrock ridges or hogbacks. The thickest deposits occur as local channel fills in scoured bedrock or behind bedrock ridges. The Rocky Flats Alluvium is composed of yellowish brown to reddish brown, poorly sorted, coarse, bouldery gravel in a sand matrix with lenses of clay, silt, and sand, and varying amounts of caliche where weathered. Pebbles, cobbles, and boulders are composed primarily of quartzite but include lesser amounts of schist, gneiss, granite, pegmatite, sandstone, and siltstone derived from older Precambrian through Cretaceous bedrock exposed west of RFP.

Other Surficial Deposits

Other surficial deposits within the Rocky Flats area consist of younger alluvial deposits, colluvium, slumps, and valley fill (EG&G, 1991b). The younger alluvial deposits cap pediments that are topographically lower than the Rocky Flats pediment. Erosion has formed deposits of colluvium on the sides of steep slopes and in the stream valleys. The valley bottoms contain valley-fill deposits deposited by sedimentation from streams. Gentle stream-cut valley walls are often covered in part by shallow slumps. These features are recognized by a curved scarp at the top, a coherent mass of material downslope that may be rotated back toward the slip plane, and hummocky topography at the base. Surficial deposits are generally composed of variable amounts of gravel, sand, silt, and clay. These deposits are derived from Precambrian rocks, younger sedimentary bedrock, and older surficial deposits.

Arapahoe Formation

The Arapahoe Formation is composed predominantly of claystones, clayey sandstones, and sandstones. The base of the Arapahoe Formation is marked by planar-laminated to trough cross-bedded, calcareous, medium-grained to conglomeratic sandstone. These conglomerates and sandstones are composed of well-rounded and frosted, medium to coarse, quartz sand grains and often include pebbles of chert, rock fragments, and ironstone (EG&G, 1992). Conglomerates and sandstones at the base of the Arapahoe Formation fill low-relief, discontinuous channel forms cut into the underlying claystones of the Laramie Formation (EG&G, 1992). At RFP, conglomeratic sandstones are sparse and occur only in thin beds within thicker sections of medium- to coarse-grained sandstone (EG&G, 1992). The coarse-grained components of the Arapahoe Formation are confined to laterally discontinuous lenses within finer-grained sediments. These lenses do not appear highly interconnected.

The formation is more than 300 feet thick in the Golden area south of RFP (Weimer, 1973); however, the upper portions of the Arapahoe Formation are not seen at RFP having been eroded prior to deposition of the Rocky Flats Alluvium. Only the lower 10 to 120 feet of the Arapahoe Formation are present at RFP (EG&G, 1992).

Laramie Formation

The Laramie Formation conformably underlies the Arapahoe Formation. The formation is approximately 600 to 800 feet thick at RFP. The lower portion (lowest 300 feet) of the Laramie Formation is composed of thick sandstones, siltstones, and claystones with discontinuous coal beds. The upper part of the Laramie Formation consists primarily of massive claystones, some with large ironstone nodules. Thin to medium lenticular beds of platy-laminated or friable, calcareous, fine-grained sandstones are also present in the upper Laramie. At RFP, the Rocky Flats Alluvium unconformably overlies the Laramie in areas where the Arapahoe Formation was completely eroded prior to deposition of the Rocky Flats Alluvium.

1.3.3.8 Hydrogeology

Unconfined ground water flows in the Rocky Flats Alluvium, which is relatively permeable compared to claystone, siltstones, and silty sandstones. Recharge to the alluvium is from precipitation, snowmelt, and water losses from ditches, streams, and ponds that are cut into the alluvium. In general, water movement in the Rocky Flats Alluvium is from west to east and toward the drainages. The water table surface in the Rocky Flats Alluvium rises in response to recharge during the spring and declines during the remainder of the year.

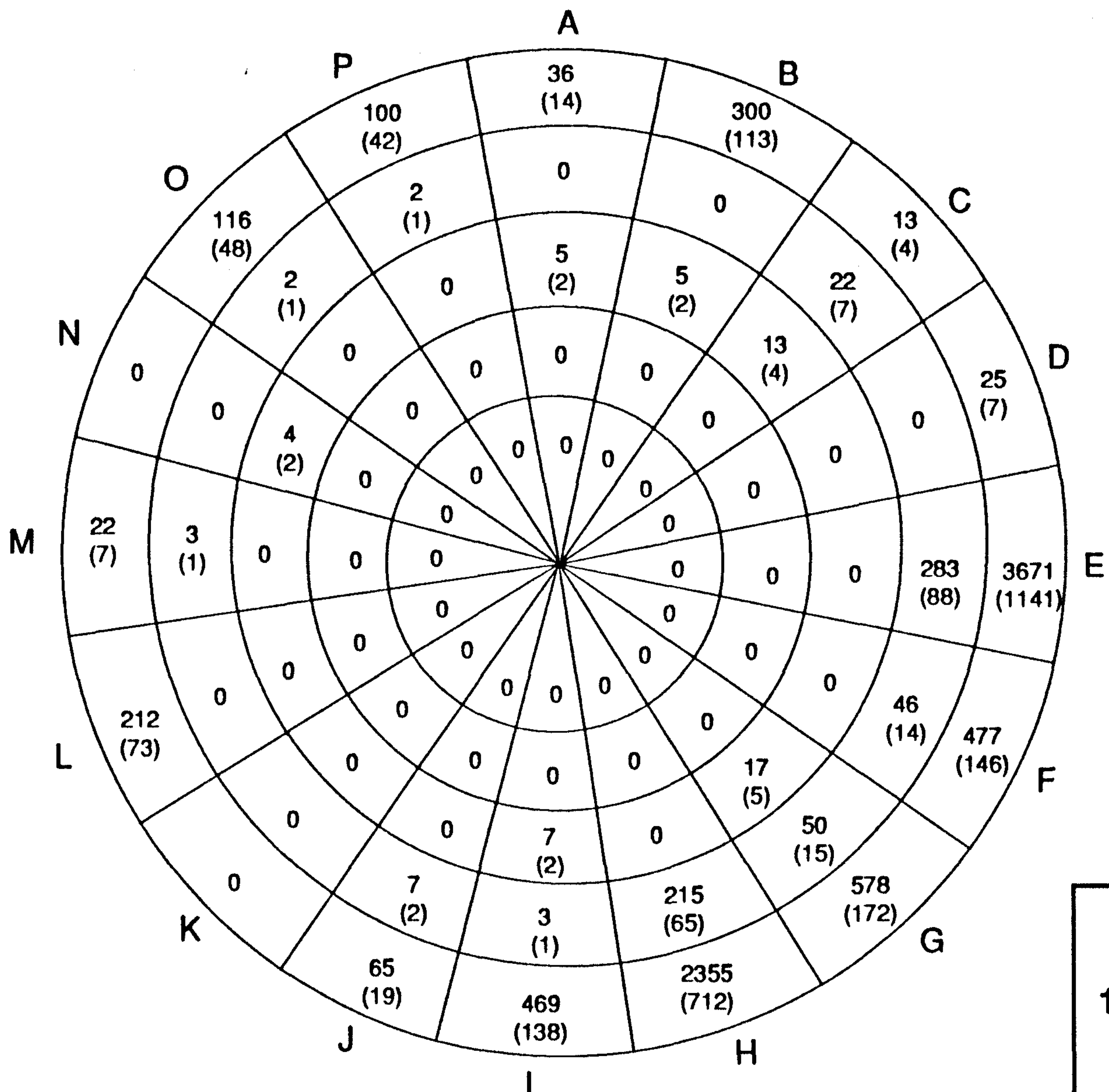
Fluctuations in the water table surface vary approximately 2 to 25 feet at RFP (Hurr, 1976). Discharge from the alluvium occurs at minor seeps in colluvial materials that cover the contact between the alluvium and bedrock along the edges of the valleys. The Rocky Flats Alluvium thins, becomes discontinuous, and is eroded from the drainages east of the plant boundary.

Unconfined ground water flows in other surficial units (alluvium, colluvium, and valley fill). Recharge occurs through precipitation, infiltration from streams during periods of surface water runoff, and seeps discharging from the Rocky Flats Alluvium. Discharge occurs through evapotranspiration and by seepage into other geologic formations and streams. The direction of ground water flow is generally to the east and downgradient through colluvial materials into valley-fill deposits that occur in the active drainages. During periods of high surface water flow, some of the water is lost to bank storage in the valley-fill alluvium and returns to the stream after the runoff subsides.

The Arapahoe Formation is recharged by ground water movement from overlying surficial deposits and by infiltration from streams. The main recharge areas are under the Rocky Flats Alluvium, although some recharge from the colluvium likely occurs along stream valleys and drainages (U.S. DOE, 1992a). Recharge is greatest during the spring and early summer, when rainfall and stream flow are at a maximum and water levels in the Rocky Flats Alluvium are high. Regionally, ground water flow in the Arapahoe Formation is toward the South Platte River in the center of the Denver Basin (Robson et al., 1981a).

RFP is situated in a regional ground water recharge area. Ground water recharge occurs primarily from infiltration of precipitation into bedrock, which outcrops in the western portion of RFP along the west limb of the monoclinal fold. Recharge also occurs as a result of seepage from streams, ditches, and ponds, and vertical infiltration into subcropping bedrock (EG&G, 1991c).

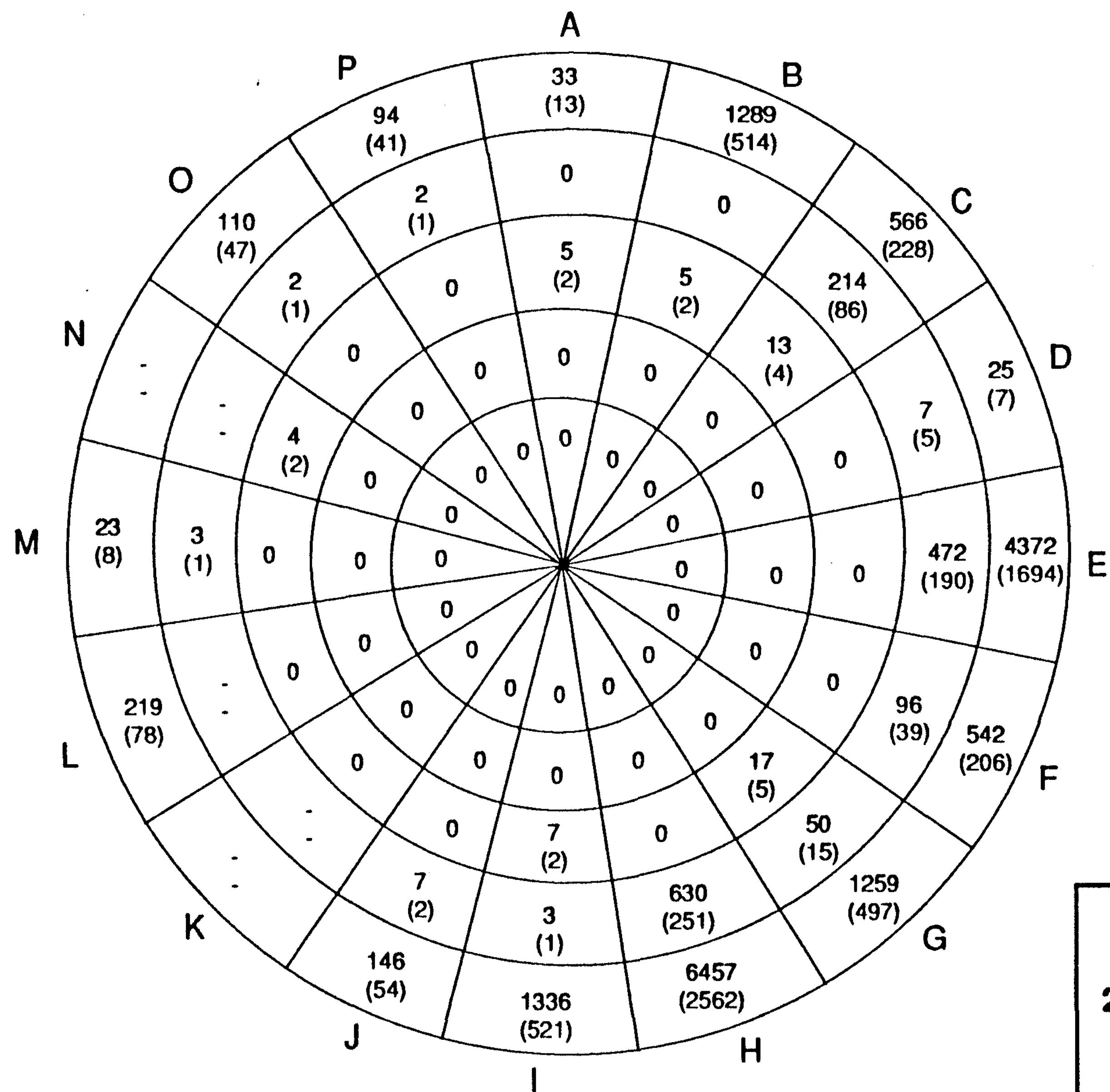
In the western portion of RFP, where the alluvium is thickest, the potentiometric surface is 50 to 70 feet below the surface. Although the depth to the potentiometric surface in the alluvium is variable, it becomes generally shallower from west to east as the thickness of the alluvium decreases. Seeps are common in stream drainages along the contact between the Rocky Flats Alluvium and the underlying Arapahoe and Laramie Formations. The direction of unconfined ground-water flow is generally to the east along the gently sloping contact between the alluvium and the underlying bedrock. Unconfined ground water also exists in subcropping Arapahoe and Laramie Formation sandstones. Ground Water in some Arapahoe Formation sandstones exists under confined conditions.



Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2-3	Sector 3
3-4	Sector 4
4-5	Sector 5

Figure 1-2
1989 POPULATIONS AND (HOUSEHOLDS), SECTORS 1-5

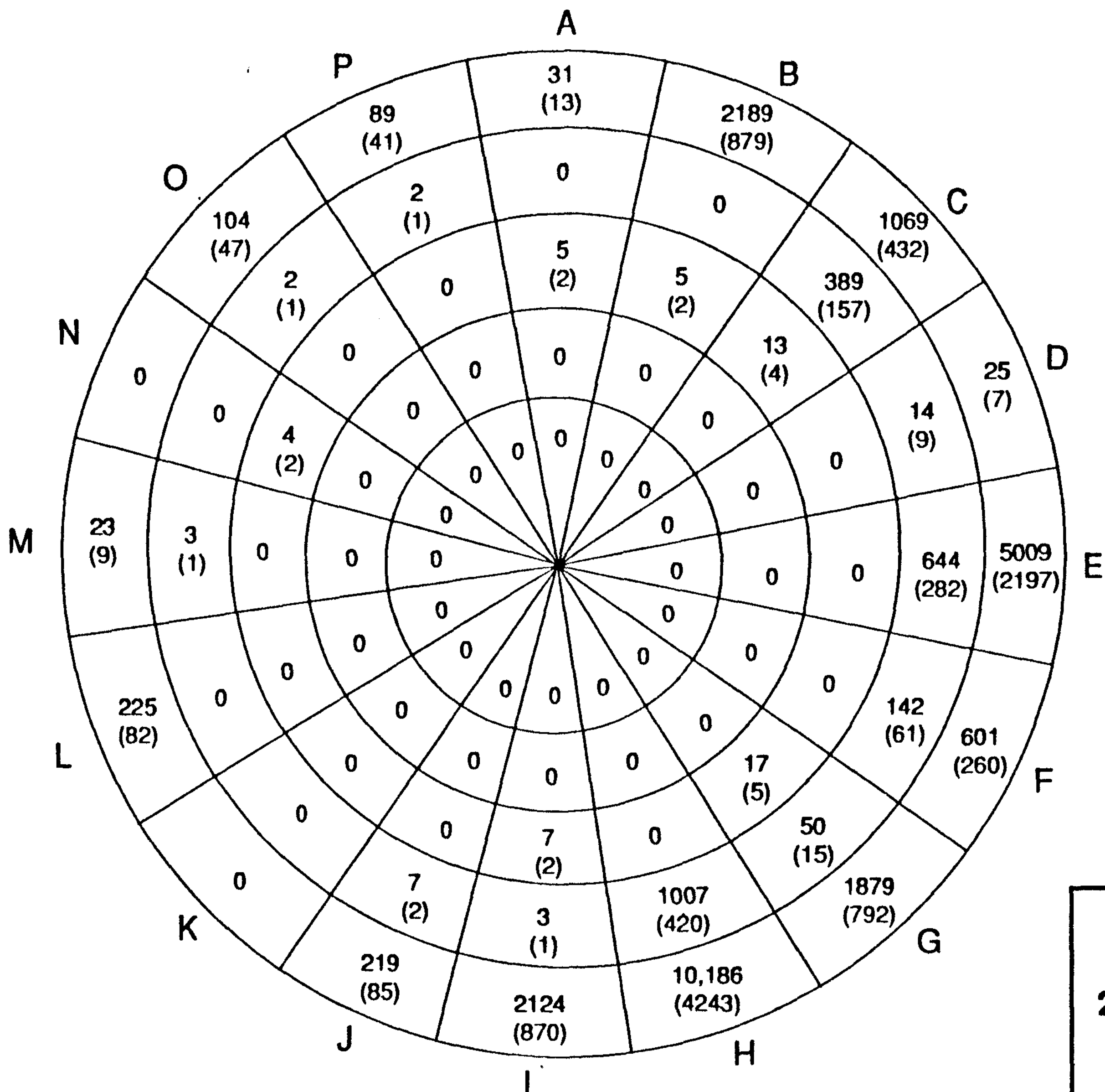
SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS)



Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2-3	Sector 3
3-4	Sector 4
4-5	Sector 5

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS)

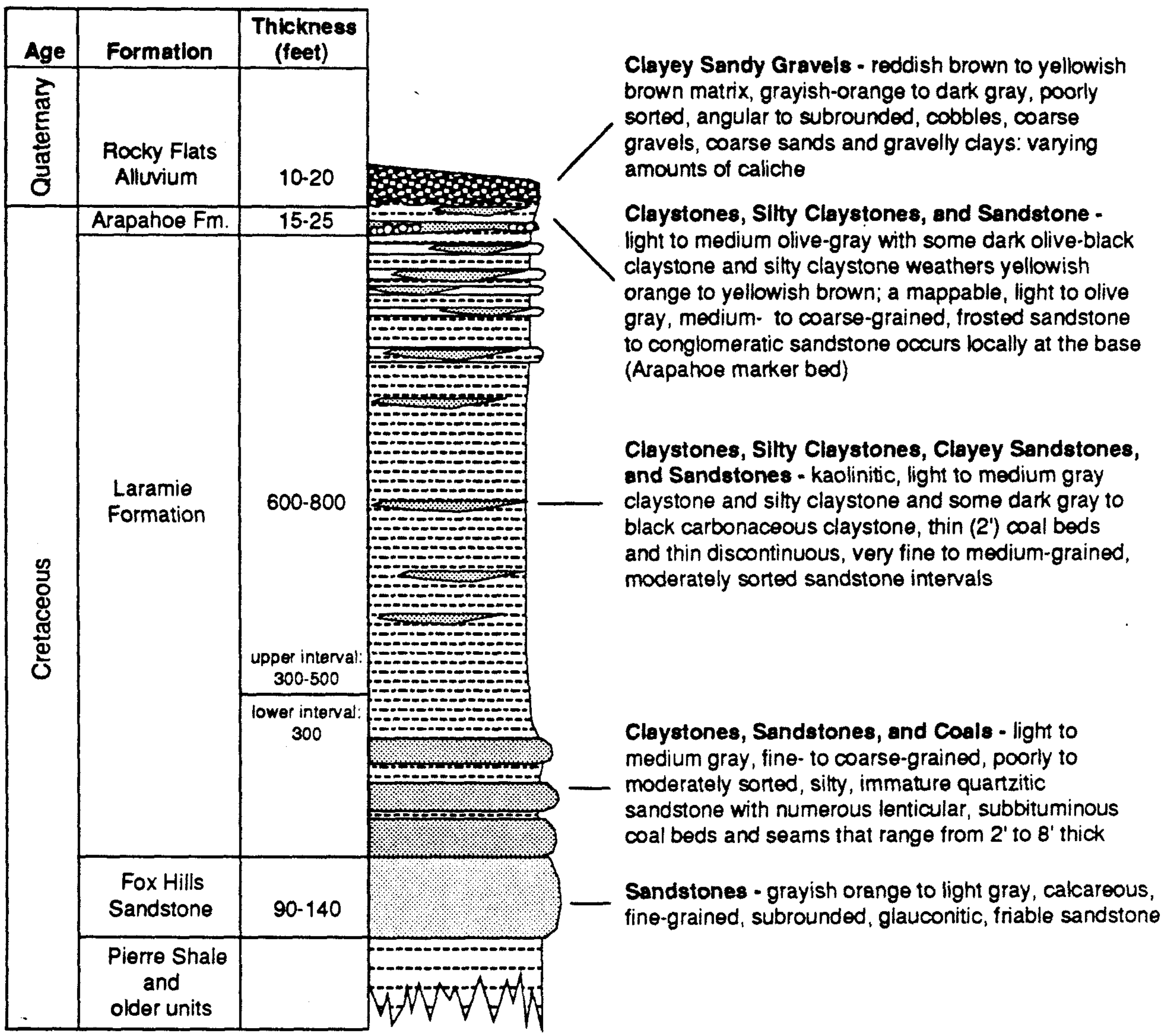
Figure 1-3
2000 POPULATIONS AND (HOUSEHOLDS), SECTORS 1-5



Miles	Sector Name
0-1	Sector 1
1-2	Sector 2
2-3	Sector 3
3-4	Sector 4
4-5	Sector 5

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS)

Figure 1-4
2010 POPULATIONS AND (HOUSEHOLDS), SECTORS 1-5



U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado

Figure 1-5

Generalized Stratigraphic Section for the Central Portion of Rocky Flats Plant

After EG&G, 1992 May 1992

Approved by:

________________ __/__/__ ________________ __/__/__

Manager, Remediation Programs RFI Project Manager

2.0 SITE CHARACTERIZATION

This RFI/RI Work Plan addresses the six IHSSs presently included within OU15. OU15 is comprised of:

IHSS 178	Building 881, Drum Storage Area (Room 165)
IHSS 179	Building 865, Drum Storage Area (Room 145)
IHSS 180	Building 883, Drum Storage Area (Room 104)
IHSS 204	Unit 45, Original Uranium Chip Roaster (Building 447, Rooms 31, 32, 501, and 502)
IHSS 211	Unit 26, Building 881, Drum Storage Area (Room 266B)
IHSS 217	Unit 32, Cyanide Bench Scale Treatment (Building 881, Room 131C)

These IHSSs are all RCRA-regulated interim status closure units located inside of buildings within the industrialized portion of RFP (Figure 2-1).

As discussed previously in Section 1.0, IHSS 212 (Building 371 Drum Storage Area) and IHSS 215 (Tank T-40) are not included in this work plan. The sites within OU15 were assigned an IHSS (formerly SWMU) reference number by Rockwell International (1987a). Details of the IHSS locations, physical characteristics, and operations are presented in Section 2.2. In Section 2.3, environmental conditions relevant to OU15 are summarized.

The initial step in development of the OU15 work plan was a review of existing information regarding the operational histories and relevant design/construction characteristics of the IHSSs. Available historical and background data for each IHSS were collected through a literature search, which included references at the Rocky Flats Public Reading Room, various RFP libraries, and a review of the Rocky Flats Environmental Database System, (RFEDS). Personal communications with plant personnel were also used as a source of information during the background data review so that each IHSS could be better described. Environmental data within and near OU15 were evaluated for applicability and useability in assessing potential for radiological and chemical releases from OU15 IHSSs to environmental media outside of the buildings.

2.1 REGULATORY HISTORY OF OU15

Units included within OU15 were first identified as RCRA-regulated interim status units in mid-1986 because records indicate that some RCRA-regulated hazardous waste or hazardous waste constituents were stored within the units. Closure plans were prepared in 1988 for IHSSs 178, 179, 180, 204, and 217 (Rockwell International, 1988a, 1988b, and 1988c). A closure plan for IHSS 211 was prepared in 1989 (Rockwell International, 1989a). Closure plans were prepared pursuant to Part 265 of the Colorado Hazardous Waste

Regulations (6 Colorado Code of Regulations [CCR]) and Title 40, Part 265 of the Code of Federal Regulations (40 CFR), and in accordance with the Compliance Agreement for RFP finalized by representatives of DOE and EPA on July 31, 1986.

In late 1986, Phase I of the DOE CEARP program (Section 1.3.2) was performed at RFP. The CEARP investigations were initiated to characterize RFP release sites, including OU15.

On January 22, 1991, DOE, EPA, and the State of Colorado entered into a Federal Facility Agreement and Consent Order, commonly known as the IAG. The IAG establishes the work and schedule for the RFI/RI and Corrective Measures Study/Feasibility Study (CMS/FS) process at RFP. OU15 is currently in the Phase I RFI/RI stage. As defined in the IAG, the Phase I RFI/RI is required to characterize the nature and extent of contamination at, or resulting from, OU15 IHSSs and the need for further action (U.S. DOE, 1991a).

2.2 UNIT DESCRIPTIONS AND OPERATIONAL HISTORIES

OU15 consists of six RCRA-regulated interim status closure units located within buildings in the RFP complex (Figure 2-1). The background and physical setting of the IHSSs that constitute OU15 are discussed below. Other operable units located adjacent to OU15 are discussed throughout Section 2.0, where applicable to the characterization of OU15. Documents that were the primary sources of information for the operational histories of the OU15 IHSSs include:

(1) Closure plans for the individual units (Rockwell International, 1988a, 1988b, 1988c, and 1989a)

(2) Historical Release Report for the Rocky Flats Plant (U.S. DOE, 1992b)

2.2.1 IHSS 178, Building 881 - Drum Storage Area (Room 165)

IHSS 178 is a drum storage area located within Room 165 of Building 881. The drum storage area was first used in 1953 when Building 881 operations began. Currently IHSS 178 is used as a RCRA 90-day accumulation area. Figure A-1 in Appendix A shows the location of Room 165 on the Building 881 floor plan. This room is located on the first floor of Building 881; there is no basement beneath Room 165.

The storage area within Room 165 measures 5 feet by 5 feet and the maximum number of 55-gallon drums that can be stored at one time is five. Drums are stored directly on the floor, which is unpainted concrete. There are no containment berms around the storage area or at the two doors.

The drums stored at this IHSS contained wastes generated within Building 881. Results of analysis of wastes from Building 881, typical of those stored in IHSS 178, are presented in Table 2-1 (Rockwell International, 1988a). These drums contained volatile organic compounds (Freon TF, 1,1,1-trichloroethane, and carbon dioxide) and possibly low-level radioactive wastes.

Routine visual monitoring for spills and/or releases was conducted during the period of operation of this storage unit. However, the frequency at which visual monitoring was conducted is not presently known. As part of the development of the closure plan for this unit, a site visit was performed during November 1986. At that time, there was no visual evidence or documentation of any spills or releases in the storage unit (Rockwell International, 1988a). Five 55-gallon drums were stored at this IHSS in November 1986. For preparation of this work plan, a site visit was performed during April 1992 to assess the current status and condition of the unit. During April 1992, no drums were stored at the IHSS on the day of the site visit. Photos number B-1 and B-2 in Appendix B show the current condition of the unit.

2.2.2 IHSS 179, Building 865 - Drum Storage Area (Room 145)

IHSS 179 is a drum storage area located in the north end of Room 145. Room 145 is located on the ground floor in the center portion of Building 865. Use of IHSS 179 began in 1970 (Rockwell International, 1988a). As of November 1986, the area was being used as a RCRA 90-day accumulation area. IHSS 179 is no longer used for drum storage.

The storage area within Room 145 is approximately 8 feet by 12 feet. The unit stored a maximum of ten 55-gallon drums. Drums in this unit were stored directly on the concrete floor. Because the unit is located in the center of a large room, there are no containment berms around the drums. The concrete floor is covered with epoxy paint to provide secondary containment. Figure A-2 in Appendix A shows the location of Room 145 and IHSS 179 on the Building 865 floor plan.

Site visits were conducted during November 1986 and April 1992 to assess the status and condition of the unit. In November 1986, two drums were stored at this IHSS. The drums contained oils, chlorinated solvents, radioactive wastes, and possibly beryllium (Rockwell International, 1988a). Following that time, chlorinated solvents were eliminated in the area where the wastes were generated. Consequently, after 1986 the stored wastes contained only oil possibly contaminated with beryllium and radioactive wastes. Visual monitoring of the drums for spills and releases was performed daily. There have been no documented releases and based on visual inspections, there was no evidence of spills.

Samples from the drums stored in the area were obtained on two dates and analyzed for total alpha, beryllium, and selected organic compounds (Table 2-2). The results of the analyses are presented in Rockwell International, February 7 through July 18, 1986, "Analytical Report" Building 865 and 883 Drum Storage Areas, Rocky Flats Plant (Rockwell International, 1986f). As indicated by the review of analytical results, volatile organic compounds, beryllium, and radioactivity were present in the drums. Any spills from the drums would have collected in a concrete pit in the floor under the EB welder, located just north of the storage area. The pit has a sump with an automatic pump operated by float switch. Accumulated liquids in the sump are transferred via overhead piping to the Building 865 process waste collection tanks in Building 886, and from there through the valve vault system to Building 374 for treatment.

Photos B-3 through B-5 in Appendix B show the current condition of the unit. During the April 1992 site visit, the epoxy-painted floor was in good condition. Photo B-3 shows the previous drum storage location in Room 145 in front of the electrical cabinet. Photo B-4 shows the unit location in relation to the EB welder, and Photo B-5 shows a close-up of the sump in the pit under the welder.

2.2.3 IHSS 180, Building 883 - Drum Storage Area (Room 104)

IHSS 180 is a drum storage area located within Room 104 of Building 883. The area has been used as a container storage area from 1981 untill present (Rockwell International, 1988a). During a portion of this time, the area was used as a 90-day accumulation area for RCRA wastes. The area is currently used for storage of low-level radioactive waste (nonhazardous).

The storage area within Room 104 measures 10 feet by 16 feet. The unit stored a maximum of thirty 55-gallon drums, which were placed directly on the floor. There are no containment berms around the drums and no drains in the floor. Samples from drums stored in the area were obtained on five separate dates and analyzed for total alpha, beryllium, and "general components." The results of the analyses are shown in Table 2-3 (Rockwell International, 1986f). As indicated by the analytical results, volatile organic compounds, beryllium, and radioactivity were present in the drums that were sampled. The wastes included oils contaminated with organic compounds and uranium. Figure A-3 in Appendix A shows the location of Room 104 on the Building 883 floor plan. Room 104 was added on to the east side of the original building and was built on grade. Visual monitoring of the storage area was conducted periodically (Rockwell International, 1988a). The frequency at which visual monitoring was conducted is not presently known. However, no documentation was found that indicates that a release occurred from drums stored at this IHSS.

A site visit was conducted during April 1992 for the purpose of assessing the unit status and condition. The unit currently stores nine 55-gallon drums containing used oil contaminated with low-level radioactive waste. There are no containment berms at the dock doors leading from Room 104 to the outside. The floor is painted concrete, but the floor coating is scuffed and in poor condition. There is a metal scale adjacent to the drum storage area that is housed in a concrete pit recessed in the floor of the room.

Photos numbers B-6 through B-8 in Appendix B show the current condition of the unit. Photo B-6 shows the drum location in Room 104. Photo B-7 shows the scale pit with the dock door in the background. Photo B-8 shows a close-up of the dock door, showing the lack of a containment berm at the base of the door.

2.2.4 IHSS 204, Unit 45, Original Uranium Chip Roaster (Building 447, Rooms 31, 32, 501, and 502)

The Original Uranium Chip Roaster is located in Rooms 32 and 502 of Building 447. IHSS 204 includes the Original Uranium Chip Roaster and Rooms 31 and 501 where drums of waste were transferred into and out of the chip roaster. The Original Uranium Chip Roaster is constructed of mild steel casing lined with alumina refractory brick. It is cylindrical with a diameter of 5 feet 6 inches and a height of 7 feet 4 inches (Rockwell International, 1988b). The unit was identified as Unit No. 45 in the 1986 RCRA Part B Permit Application. Figure A-4 in Appendix A shows the location of Rooms 31, 32, 501, and 502 on the Building 447 floor plan.

The unit oxidizes elemental uranium to uranium oxide. Elemental uranium is a pyrophoric solid that can spontaneously combust upon exposure to air. Conversion to uranium oxide controls the pyrophoric characteristics of the material allowing for safer storage and handling. The depleted uranium chips originated from the Building 444 production area and were coated with small amounts of oils and coolants (Freon TF and 1,1,1-trichloroethane). Chips were stored in 55-gallon drums and transfered to Room 501 in Building 447 for roasting.

Before roasting, the chips were rinsed with hot water to remove excess coatings. The rinsate was disposed of in the building process drain. The chips were fed into the top of the roaster at a rate of approximately three 55-gallon drums per day. The chips ignited upon entry and sustained self combustion throughout the roasting cycle. Chips were fed down the four tiers of the roaster which consisted of grates with rotating paddles that caused the chips to fall to successively lower tiers. The chips were completely oxidized when they reached the bottom of the roaster. The uranium oxide fell through a hole in the bottom of the unit and was collected in 30-gallon drums. The hot uranium oxide collected in the drums was allowed to cool for approximately two to three days prior to transfer. Exhaust gases created during this process passed through three High Efficiency Particulate Air (HEPA) filter banks, one located in the roaster stack and two others located in the main building plenum (Rockwell International, 1988b).

An incident involving the roaster occurred in Room 32 of Building 447 on June 28, 1985. An operator had filled a barrel with hot uranium oxide and, in replacing it with a new barrel, placed the thermally hot barrel next to some cardboard. About three hours later, the cardboard ignited, setting off the sprinklers and fire alarm. The basement of the building flooded. The RFP Fire Department responded to the incident and the water in the basement was vacuumed up. All combustibles were removed from Room 32 (Rockwell International, 1988b).

2.2.5 IHSS 211, Unit 26, Building 881 - Drum Storage Area (Room 266B)

IHSS 211 is a drum storage area located in Room 266B on the second floor of Building 881. Since May 16, 1989, Unit 26 has been operating as a 90-day mixed waste drum storage area. Prior to this time, Unit 26 operated as a long-term storage area for mixed wastes and was included in the hazardous and low-level mixed waste RCRA Part B Permit Application. The unit was used as a drum storage area beginning in 1981. The unit can store a maximum of twenty-nine 55-gallon drums. The wastes stored at this unit included both liquids and solids generated from the General Laboratories. Room 266B is located on the second floor of Building 881 and measures 10 feet by 20 feet. Figure A-5 in Appendix A shows the location of Room 266B on the Building 881 floor plan. The floor is constructed of concrete, the surface of which is sealed with epoxy paint to provide secondary containment. There are no containment berms around the storage area. The 55-gallon drums of mixed waste are stored in three rows, each row separated by a nominal 2-foot wide aisle. The steel drums are stored directly on the floor. Aisle space (minimum 1-foot 3-inches) is maintained to allow access for weekly container inspections to visually assess the structural integrity of the drums and to check for leaks, visual evidence of spills, or corrosion of drums (Rockwell International, 1989a).

According to interviews with Rockwell operations and supervisory personnel, a release of waste from the drums stored in this area has not occurred (Rockwell International, 1989a).

Unit 26 is used to store containerized low-level radioactive mixed wastes. These wastes are generated in the General Laboratory in Rooms 137, 255, 266, 272, and 276 as laboratory process waste and consist of the following four types:

1. Low-level combustible waste, including paper, Kimwipes, surgeon gloves, and plastic contaminated with uranium-238

2. Low-level metal and glass waste or materials contaminated with uranium-238.

3. Low-level combustible hazardous wastes (same as 1 with the possibility of contamination with hazardous solvents and/or metals)

4. Low-level metal and glass waste or materials contaminated with hazardous solvents.

Table 2-4 identifies wastes approved for storage in Unit 26, along with corresponding waste stream identification numbers. The waste stream numbers were generated from a waste stream identification and characterization (WSIC) study conducted at RFP in 1986 and 1987 (Rockwell International, 1986g, 1986h, 1986i, 1986j, and 1987b). The solvents potentially contaminating the solid waste include volatile organic compounds (carbon tetrachloride, acetone, methyl alcohol, and butyl alcohol). Inorganic wastes generated in the General Laboratory include the following Target Analyte List (TAL) metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, and thallium.

The wastes are reviewed at the point of generation or at initial satellite collection areas in Rooms 137, 255, 266, 272, and 276 and placed in 55-gallon drums on a continuous basis. Identification is by type of waste, date, and name of generator. After a drum is full, it is transferred to Unit 26 for storage. Hazardous Waste Operations transfers drums containing chemical waste from Unit 26 to Unit 13, Building 884 for long-term storage. Drums containing radioactive mixed wastes are transported to Building 889 for repackaging.

A site visit was conducted during April 1992 for the purpose of assessing the unit status and condition. There are no containment berms at the two doors. The floor is epoxy-painted concrete to provide secondary containment. At the time of the site visit, the coating of paint was in good condition. Photo number B-9 in Appendix B shows the current condition of the unit. There were no drums stored in the unit on the day of the site visit.

2.2.6 IHSS 217, Unit 32, Cyanide Bench Scale Treatment (Building 881, Room 131C)

IHSS 217 is a cyanide bench scale treatment process (RCRA Unit 32) located in Room 131C of Building 881. Room 131C located on the first floor of Building 881. The unit consists of a 4 foot by 5 foot painted metal fume hood and laboratory table, three 4-liter polyethylene bottles, a glass beaker, and a chlorine-specific ion electrode. Figure A-6 in Appendix A shows the location of IHSS 217 and Room 131C on the Building 881 floor plan.

The bench scale treatment process converts cyanide to cyanate. Aqueous cyanide solutions resulting from analyses of environmental samples (ground water, surface water, etc.) in other laboratories were transferred to Unit 32 for analysis of cyanide content using a cyanide still. Very low concentrations of other listed hazardous wastes may have been in these solutions.

Wastes generated from this analysis were collected in the three 4-liter polyethylene bottles stored in the steel fume hood of the unit. The bottom of the fume hood acted as a secondary containment system in the event of a spill. There was no automated monitoring system for detecting releases. No more than five liters of the cyanide waste were stored in the unit at any given time. During the 24 hours that it took to neutralize one 4-liter bottle of cyanide solution, any additional cyanide solution was accumulated in the other 4-liter bottles. When a bottle was full, which normally took approximately two months, the contents were treated in the bottle with sodium or calcium hypochlorite to oxidize the cyanide to cyanate. A residual chlorine-specific ion electrode was used to determine when the conversion was complete. The neutralized solution was poured down a process waste drain located in Room 131C and transferred via the process waste line system to Building 374 for further treatment (Rockwell International, 1988c). The cyanate resulting from the neutralization process is not a listed hazardous material. The drain is used for disposal of other wastes generated in the laboratory. As a result, this drain and the associated piping will be investigated separately from IHSS 217.

The average concentration of cyanide stored in the bottle was less than 20 parts per million (ppm). The maximum concentration of cyanide ever added to the bottles was 100 ppm, however, this would mix with other contents of the bottle to produce cyanide concentrations below 20 ppm. There have been no documented releases from the polyethylene bottles or spills during transfer or neutralization. Because cyanide is a listed waste, this waste treatment unit is regulated by RCRA.

A site visit was conducted during April 1992 for the purpose of assessing the status and condition of the unit. The hood appears to be metal covered with a coat of paint. The hood has an integral lip across the front, which provides containment of any wastes spilled within the hood. Photo number B-10 in Appendix B shows the current condition of the hood.

2.3 SITE CONDITIONS

The description of the site conditions in the vicinity of OU15 was derived from previous site-wide studies and RFI/RI work plans prepared for OU1, OU2, OU4, OU5, and OU9. The information presented in these work plans has been used to characterize the environmental setting of the OU15 IHSSs. However, little if any of the environmental information presented in these documents is directly relevant to an assessment of contamination of environmental media outside of the buildings resulting from OU15 IHSSs.

Previous investigations that were the primary sources of information regarding the environmental setting of OU 15 include:

1. Final Phase I RFI/RI Work Plan, Original Process Waste Lines - Operable Unit No. 9, Rocky Flats Plant, February 1992 (U.S. DOE, 1992a)

2. Final Phase I RFI/RI Work Plan, Solar Evaporation Ponds - Operable Unit No. 4, Rocky Flats Plant, January 1992 (U.S. DOE, 1992c)

3. Final Phase III RFI/RI Work Plan, 881 Hillside - Operable Unit No. 1, Rocky Flats Plant, February 1992 (U.S. DOE, 1992d)

4. Phase II Geologic Characterization, Task 6 Surface Geologic Mapping Report (EG&G, 1991b)

2.3.1 Topography

Most of OU15 is located within the controlled area of the main plant, which lies on an erosional pediment informally referred to as the Rocky Flats mesa. The Rocky Flats mesa is a flat alluvial-covered pediment that slopes gently to the east at approximately one degree. The pediment and alluvial cover are dissected by several small eastward flowing streams. These stream-cut valleys are incised into the bedrock and lie 50 to 200 feet below the pediment surface. Much of the ground surface in the controlled area of RFP has been disturbed by earthwork construction, thus obscuring original topographic undulations. Typical existing slopes in the controlled area are approximately two to three percent. IHSSs 178, 211, and 217 are located in Building 881, which is situated along the southern edge of the controlled area. IHSSs 179, 180, and 204 are more centrally located. Building 881 is located at the crests of the mesa where side slopes run down into the drainage of Woman Creek (Figure 2-1).

2.3.2 Site Geology

Information for the description of the site geology was obtained primarily from the July 1991 Draft Final Geologic Characterization Report (EG&G, 1991c), the March 1992 Phase II Geologic Characterization Surface Geologic Mapping Report (EG&G, 1992), and from the RFI/RI Work Plans prepared for OU1, OU4, and OU9 (U.S. DOE, 1992d, 1992c, and 1992a, respectively).

2.3.2.1 Surficial Geology

Surficial deposits in OU15 consist of Rocky Flats Alluvium, colluvium, valley-fill alluvium, disturbed ground, and artificial fill. These surficial deposits unconformably overlie the bedrock units. The main RFP facilities area is located on a pediment surface (or mesa) capped by Rocky Flats Alluvium. Colluvium (slope wash) covers the hillsides of the terrace, and valley-fill alluvium is present in the drainages of South Walnut Creek, Woman Creek, and along the flow of smaller intermittent streams within OU15. The streams do not affect any of the IHSSs comprising OU15. In addition, there are a few isolated exposures of claystone and sandstone bedrock located along slopes and in the road cut directly east of the controlled area. Most of the surficial deposits in OU15 consist of disturbed ground overlying the Rocky Flats Alluvium and bedrock in the main part of the RFP and colluvium in the South Walnut Creek drainage. Artificial fill covers the area around Building 881. There is very little undisturbed Rocky Flats Alluvium remaining within OU15.

A surficial deposit isopach map (Figure 2-3), produced from a similar figure found in the July 1991 Draft Final Geologic Characterization Report, was used to estimate total surficial deposit thickness at various locations in OU15. The total thickness of surficial deposits (equals depth to bedrock) is not a measure of the thickness of the Rocky Flats Alluvium, as alluvial deposits, colluvium, and artificial fills are not distinguished from one another on this map. As a result, the total thickness of the surficial deposits is highly variable. In some areas, surficial deposits are so thin that the bedrock is locally exposed at the surface. Surficial deposits are thickest on the western edge of OU15 where Rocky Flats Alluvium is more than 30 feet thick southwest of Building 447. Surficial deposits generally thin along drainage slopes and to the east. Near the center of OU15, under Buildings 865 and 883, surficial deposits are approximately 10 feet thick.

Rocky Flats Alluvium

The Quaternary Rocky Flats Alluvium is the oldest and topographically highest alluvial deposit at RFP. The Rocky Flats Alluvium consists of a series of coalescing alluvial fans deposited by braided streams. Rocky Flats Alluvium capped the pediment at RFP prior to plant construction. Much of the alluvium on the plant site was removed and/or reworked during construction activities.

The Rocky Flats Alluvium is an unconsolidated deposit composed of well-graded (poorly sorted), angular to subrounded cobbles, angular to rounded coarse gravel, coarse sands, and gravelly clays. Generally, it is coarser grained to the west and becomes finer grained toward the east. Colors of the Rocky Flats Alluvium include light brown to dark yellowish orange and grayish orange to dark gray. Trough cross-bedding may be present in gravelly sands. The thickness of the Rocky Flats Alluvium in OU15 ranges from less than 1 foot to approximately 35 feet. All of the Rocky Flats Alluvium was eroded from the drainages of North and South Walnut Creeks. Colluvium and valley-fill alluvium were subsequently deposited along the slopes and in the drainage bottoms.

The amount of caliche ($CaCO_3$) mineralization in the interstices (pore spaces) of the alluvium ranges from zero to almost 100 percent. In areas where caliche has been defined as "abundant," the amount of caliche in the interstices is greater than 25 percent over a one- to two-foot interval (EG&G, 1991c). It is believed that in OU15, the amount of caliche generally increases as the thickness of the Rocky Flats Alluvium decreases (EG&G, 1991c). The amount of caliche may have hydrogeologic significance and is discussed further in Section 2.3.3.2.

Colluvium

Colluvial materials (slope wash) are present on hill slopes northeast and east of OU15, and along the slopes of Woman Creek south of OU15.

Colluvium is described as consisting predominantly of unconsolidated clay with common occurrences of silty clay, sandy clay, and gravel layers. Color ranges from dark yellowish brown to light olive gray and light olive brown. Occasional dark yellowish orange iron-oxide staining and stringers of brownish gray are present. Sand, where present, is very fine-grained to coarse-grained and poorly sorted. Occasional cobbles occur within gravel layers, which are poorly sorted and unconsolidated.

Valley-Fill Alluvium

Valley-fill alluvium is present in modern stream drainages. North of OU15 valley-fill alluvium occurs in the drainages of North and South Walnut Creek. It is derived from reworked and redeposited older alluvium and bedrock materials. The valley-fill alluvium consists of unconsolidated, poorly sorted sand, gravel, and pebbles in a silty clay matrix. Colors range from olive gray to dark yellowish orange and dark yellowish brown.

Disturbed Ground

Much of the soils in the controlled area of the RFP have been disturbed by building and road construction. Disturbed ground is generally described as unconsolidated clay, silt, sand, gravel, and pebbles. The materials are very well-graded (poorly sorted) with fragments of claystone and contain no visible bedding. Colors range from olive to reddish brown to yellowish gray and gray to yellowish orange. Angular to subangular gravels and pebbles of granite and quartzite are commonly found in areas of disturbed Rocky Flats Alluvium or disturbed colluvium. Sand, where present, varies from fine-grained to coarse-grained and is very poorly sorted. Soil deposits in the area of disturbed ground range in thickness from 0.8 feet at Well 32-86 (north of Pond 207-A) to greater than 21 feet at boring SP07-87 (east of Pond 207-B South).

Artificial Fill

There is an area of artificial fill mapped around Building 881 on Figure 2-3. Material excavated for the Building 881 foundation was spread over a large area generally south of the building. The very well-graded and unconsolidated artificial fill was derived from Rocky Flats Alluvium, colluvium, and fragments of claystone and concrete rubble. It is predominantly composed of sandy clay with some gravelly zones. Sand and gravel fill material is expected to have been backfilled in some of the tank and pipe excavations. The fill is generally brown to gray in color with occasional zones of moderate yellowish brown staining.

2.3.2.2 Bedrock Geology

The Upper Cretaceous Arapahoe and Laramie Formations unconformably underlie surficial deposits in OU15 (Figure 2-3). Depth to bedrock (Figure 2-2) ranges from less than one foot along modern drainage slopes to approximately 35 feet west of Building 447. Weathering of bedrock is common at depths of 1 to 20 feet below the base of surficial deposits and is observed to penetrate up to approximately 30 to 40 feet (EG&G, 1991c).

Open and healed fractures have been observed in bedrock at depths up to 220 feet although most that have been described as open are currently believed to be induced during drilling. Healed fractures commonly occur in claystones, siltstones, and very fine-grained sandstones. The fractures are generally less than one millimeter wide and are commonly cemented with host rock argillaceous cement and matrix material (EG&G, 1991c).

Arapahoe Formation

The Arapahoe Formation is composed predominantly of claystones, silty claystones, and clayey sandstones except at the base where conglomeratic and medium- to coarse-grained sandstones are locally present. The Arapahoe Formation is 15 to 25 feet thick beneath RFP (Figure 1-5) and dips gently to the east at approximately one to two degrees (EG&G, 1992). Its contact with the overlying surficial deposits generally parallels surface topography. The contact between the Arapahoe Formation and the underlying Laramie Formation is marked by the presence of a discontinuous, but mappable, light to olive gray, medium- to coarse-grained, frosted-quartz sandstone to conglomeratic sandstone (Figure 1-5). The lateral continuity and maximum thickness of this marker sandstone at the base of the Arapahoe has not been described for OU15. However, in the central portion of RFP (controlled area), the marker sandstone is stratigraphically equivalent to the Number One Sandstone described in the July 1991 Draft Final Geologic Characterization Report.

Most of the Arapahoe sandstones are fine- to medium-grained, platy-laminated to ripple-laminated, friable to indurated, calcareous or pyritic, light olive gray sandstones. The color of weathered sandstones is commonly pale orange to yellowish gray and dark yellowish orange due to iron-oxide staining. Medium- to coarse-grained and conglomeratic sandstones at the base of the Arapahoe are lithologically distinctive. They are thick- to medium-bedded, planar laminated to trough cross-bedded, yellowish gray to dark yellowish orange, and calcareous with an abundance of well-rounded, frosted quartz sand grains. In the OU15 area, medium-grained to conglomeratic marker sandstones occur at elevations between 5965' and 5920' above mean sea level (EG&G, 1992). They are overlain by claystones and silty claystones but may be in contact with surficial deposits at some locations within OU15. Recent sitewide investigations conducted by EG&G indicate that the Arapahoe dips approximately 2 degrees to the east and that the sandstone units may not be continuous.

The Arapahoe claystones and silty claystones are massive and blocky, containing occasional thin laminae and stringers of sand and silt. Unweathered claystones and silty claystones are light to medium olive gray and occasionally olive black. Weathered claystones appear orange and yellowish brown due to iron-oxide staining. Leaf fossils and organic matter occur throughout the claystones.

Laramie Formation

The Laramie Formation is approximately 600 to 800 feet thick at RFP and conformably underlies the Arapahoe Formation (EG&G, 1992). Where the Arapahoe Formation has been eroded from the top of the Cretaceous section, such as within modern stream drainages (Figure 2-2), the Laramie Formation may be in direct contact with surficial deposits (colluvium, valley-fill alluvium, artificial fill, disturbed ground) or exposed at the surface. The lower contact of the Laramie Formation is conformable with the older Fox Hills Sandstone.

The lower portion of the Laramie Formation is approximately 300 feet thick. The lower Laramie is composed of thick, light to medium gray, fine- to coarse-grained, poorly to moderately sorted, quartzite sandstones interbedded with blocky, brownish gray claystones, grayish black carbonaceous shales, and numerous lenticular, sub-bituminous coal beds and seams that range from 2 to 8 feet thick.

The upper portion of the Laramie Formation is generally distinguished from the lower Laramie where the formation becomes dominantly composed of fine-grained sedimentary rocks (primarily claystones) with no thick sandstone beds. The upper Laramie Formation is approximately 300 to 500 feet thick and consists primarily of olive gray to yellowish orange claystones with large ironstone nodules. Lenticular beds of platy laminated or friable, calcareous, fine-grained, light olive gray sandstones are also present and occur with greater frequency at higher levels in the section (EG&G, 1992). These sandstones are lithologically similar to the fine-grained sandstones in the overlying Arapahoe Formation, and they are concentrated within discontinuous, lenticular-shaped units that have erosional lower bounding surfaces.

In OU15, the Laramie Formation is present at elevations below 5965' on its western side and below 5920' to the east. Sandstone units may subcrop beneath surficial deposits but their lateral continuity has not been described. The 1991 Geologic Characterization Report (EG&G, 1991c) identified up to four mappable sandstone intervals in drill cores from the OU15 area. These sandstone intervals have highly variable thicknesses but generally range from 0 to 15 feet.

2.3.3 Hydrogeology

Information for the hydrology discussion was obtained primarily from the Phase I work plans for OU1 and OU9, the Draft Final Geologic Characterization Report (EG&G, 1991c), and the Phase II Geologic Characterization (EG&G, 1992). This section discusses surface and subsurface hydrogeology specific to OU15.

2.3.3.1 Surface Water

OU15 lies within the watersheds of three west to east flowing streams: North Walnut, South Walnut, and Woman Creeks. There are retention ponds in each of the creeks downstream of OU15 (Figure 2-4). In North Walnut Creek, there are four ponds designated A-1, A-2, A-3, and A-4, from west to east. Currently, Ponds A-1 and A-2 are used only for spill control, and North Walnut Creek stream flow is diverted around them through an underground pipe. Previously (until 1980), Ponds A-1 and A-2 were used for storage and evaporation of plant laundry water. Pond A-3 receives the North Walnut Creek stream flow and runoff from the northern portion of controlled area (and OU15). Pond A-4 is designed for surface water control and for additional storage capacity for overflow from Pond A-3.

Five retention ponds located along South Walnut Creek are designated B-1, B-2, B-3, B-4, and B-5, from west to east. Currently, Ponds B-1 and B-2 are reserved for spill control, whereas Pond B-3 receives treated effluent from the sanitary sewage treatment plant. Ponds B-4 and B-5 receive surface runoff and occasionally collect discharge from Pond B-3. Pond B-5 receives runoff from the central portion of RFP (and OU15) and is used for surface water control in addition to collecting overflow from Pond B-4.

The two C-series ponds, C-1 and C-2 (south and east of the plant, respectively), are located along Woman Creek. Pond C- 1 receives stream flow from Woman Creek. This flow is diverted around Pond C-2 into the Woman Creek channel downstream. Pond C-2 receives surface runoff from the South Interceptor Ditch along the southern portion of RFP.

Surface water drainage in OU15 is controlled for the most part by water diversion works such as ditches, pavements, gutters, drains, and culverts. Surface water drainage patterns in the controlled area are shown in Figure 1-2. The largest of the runoff control ditches in the controlled area is the Central Avenue Ditch which runs eastward along Central Avenue and discharges to South Walnut Creek (Pond B-5). The other major runoff control ditch is the South Interceptor Ditch, which prevents runoff from the south side of the RFP main production area from entering Woman Creek; the ditch discharges to Pond C-2.

The discharges from the ponds are monitored to document compliance with NPDES permit requirements. In addition to NPDES monitoring requirements, all offsite pond discharges are monitored for concentrations of plutonium, americium, uranium, and tritium.

2.3.3.2 Ground Water

Available information on ground water in the controlled area where OU15 exists is from investigations of the 881 Hillside (OU1) and Woman Creek (OU5) along the southern boundary of the controlled area. Ground water flows in surficial materials (Rocky Flats Alluvium, colluvium, valley-fill alluvium, artificial fill, and disturbed ground) and in the Arapahoe and Laramie formation sandstones and claystones. The "uppermost aquifer" at OU15 consists of surficial materials, weathered bedrock units, and subcropping sandstones.

Ground water is present in surficial materials at OU15 under unconfined conditions. Both ground-water recharge and discharge occurs in OU15. Ground water recharge occurs as infiltration of incident precipitation and intermittently as infiltration from ditches, creeks, and ponds. Recharge conditions in the main plant area may differ from those in undeveloped areas because of the greater amount of paved and covered surfaces. Discharge occurs as evapotranspiration and in ditches, creeks, and seeps along slopes and drainage valleys at the alluvium/bedrock contact. Evapotranspiration represents a significant loss to the overall water budget in OU15.

The ground-water flow system in surficial materials is dynamic, with relatively large potentiometric surface elevation changes occurring in response to precipitation events and to stream and ditch flow (Hurr, 1976). There are also seasonal variations in the saturated thickness of the surficial materials. Based on the potentiometric map for OU15 surficial materials (Figure 2-4), the direction of ground-water flow is generally toward the east. However, the direction of ground-water flow is toward the southeast, south of Building 881 (i.e., towards Woman Creek). The main plant area is situated on a ground-water divide, which lies approximately west-east beneath Central Avenue. Consequently, much of OU15 is upgradient of the 881 Hillside (OU1) and Woman Creek (OU5). Generally, the direction of ground-water flow along the lower contact of the surficial material with the underlying Arapahoe Formation claystones is in the downgradient direction. At present, there are no hydraulic conductivity data specific to the areas immediately around the buildings in which the OU15 IHSSs are located. However, sitewide data are available.

The uppermost aquifer is a heterogeneous deposit, which displays a significant degree of lithologic variability laterally and vertically. Consequently, the uppermost aquifer materials exhibits a highly variable range of hydraulic conductivity values. Hydraulic conductivity values reported for the Rocky Flats Alluvium range from 1×10^{-2} centimeters per second (cm/s) (Hurr, 1976) to 4×10^{-8} cm/s (U.S. DOE, 1988). The lower Arapahoe Formation sandstones have a reported hydraulic conductivity of approximately 1×10^{-6} cm/s (EG&G, 1991c). The most recent hydrogeologic investigation suggests that the hydraulic conductivity of the uppermost aquifer is approximately 6×10^{-5} cm/s (EG&G, 1991c).

2.4 NATURE OF CONTAMINATION

A discussion of the nature of potential contaminants in the OU15 sources is presented in this section. The primary emphasis is placed on characterizing the composition of the wastes stored or processed at the IHSSs comprising OU15. The characterization is based on information presented in the closure plans and WSIC reports (Rockwell International, 1986g, 1986h, 1986i, 1986j, and 1987b) for wastes generated in the buildings in which waste was stored.

Analytical data from two other sources (HEPA filter samples and samples of sumps and footer drains) were evaluated for use in characterizing contaminant sources within OU15. However, these data are not considered applicable or useable because the samples represent contamination associated with the entire building and not the individual IHSSs. Therefore, it would be impossible to differentiate contamination related to OU15 IHSSs from contamination related to a spill, release, process or other activity occurring elsewhere in a building.

2.4.1 Waste Characteristics

The characteristics of wastes associated with OU15 IHSSs are addressed in Section 2.3. At the four drum storage areas, a variety of wastes are potential contaminants. At IHSS 178, volatile organic compounds (VOCs), and possibly radioactive wastes, were stored in drums. At IHSS 179, oils, chlorinated solvents, radioactive wastes, and possibly beryllium were stored in drums. At IHSS 180, VOCs, beryllium and radioactive wastes were stored in drums along with oils contaminated with other organic compounds and uranium. A variety of solid and liquid wastes were present within IHSS 211. These wastes include VOCs, metals, and low-level radioactive mixed wastes contaminated with uranium-238. At IHSS 204, the Original Uranium Chip Roaster, potential contaminants consist of uranium chips coated with oil and organic solvents. At IHSS 217, the waste material contained within the

4-liter polyethylene bottle(s) and potentially contaminating the laboratory table and fume hood with cyanide are considered the primary source of contamination.

2.4.2 Sources/Releases

The drums of wastes stored at IHSSs 178, 179, 180, and 211 are the primary sources of contamination at OU15 drum storage areas. As discussed in Section 2.2, routine visual monitoring for spills, leaks, and releases was performed at most of the IHSSs. According to interviews with plant personnel, releases of wastes from the drums stored in these areas has not occurred. The Original Uranium Chip Roaster and drums of wastes stored in Rooms 31 and 501 during transfer into and out of the unit represent the primary source of potential contamination at IHSS 204. At IHSS 217, the 4-liter polyethylene bottle(s) which contained neutralized cyanide waste and the laboratory table and fume hood are considered the primary source of contamination.

2.5 SITE CONCEPTUAL MODEL

This section develops a site conceptual model for the IHSSs within OU15 based on the unit descriptions, site conditions, and nature of contamination discussed in Sections 2.2, 2.3, and 2.4, respectively. A site conceptual model is intended to describe known and suspected sources of contamination, types of contamination, affected media, contaminant migration pathways, and environmental receptors. The site conceptual model is used to assist in identifying sampling needs to obtain information for evaluating the need for further action at OU15 IHSSs.

Figure 2-5 shows the elements of a generic site conceptual model. The elements of the site conceptual models for the IHSSs within OU15 are discussed below.

The primary purpose of the conceptual model is to aid in identifying exposure pathways by which human and biotic receptors may be exposed to contaminants. The EPA defines an exposure pathway as ". . . a unique mechanism by which a population may be exposed to chemicals at or originating from the site . . ." (U.S. EPA, 1989b). As shown in Figure 2-5, an exposure pathway must include a contaminant source, a release mechanism, a transport medium (pathway), an exposure route, and a receptor. An exposure pathway is not complete without each of these five components. The individual components of the exposure pathway are defined as follows:

- Contaminant Source (Section 2.5.1): For purposes of the OU15 conceptual model, the contaminant source is divided into primary sources (i.e., the IHSSs within the buildings) and secondary sources (i.e., environmental media outside of the buildings which potentially have been directly affected by releases from OU15 IHSSs).

- Release Mechanisms (Section 2.5.2): Release mechanisms are physical and chemical processes by which contaminants are released from the source. The conceptual model identifies primary release mechanisms, which release contaminants directly from the IHSSs (in this case, leaks and spills) and secondary release mechanisms, which release contaminants from environmental media.

- Transport Medium (Pathway) (Section 2.5.2): Transport media are the media into which contaminants are released from the source and from which contaminants are in turn released to a receptor (or to another transport medium by a secondary release mechanism). Primary transport media within the buildings include air, water/waste liquids, and biota (humans). Secondary transport media include air, surface water, ground water, and biota (humans) outside the buildings.

- Exposure Route (Section 2.5.3): Exposure routes are avenues through which contaminants are physiologically incorporated by a receptor. Exposure routes for receptors at OU15 are inhalation, ingestion, and dermal contact.

- Receptor (Section 2.5.3): Receptors are primarily human populations that are affected by the contamination released from a site. Human receptors for OU15 primarily include RFP workers and visitors. Environmental receptors include biota (both flora and fauna) indigenous to the OU15 environs.

The conceptual model provides a contaminant source characterization and an overview of all the potential exposure pathways that may result from releases from and into each transport medium (Section 2.5.4). Some of these pathways have a higher potential for occurrence than others. Significant exposure pathways are identified by evaluating the fate and mobility of the contaminant in each potential source and transport medium.

2.5.1 Contaminant Source

As shown in Figures 2-6 and 2-7, drums of stored wastes are the primary source of contamination at OU15 drum storage areas - IHSSs 178, 179, 180, and 211. If releases from the drums stored in these areas occurred, exited the buildings, and impacted environmental media, then the contaminated environmental media (e.g., soil) would be considered a secondary contaminant source.

The Original Uranium Chip Roaster and associated drums of wastes stored in Rooms 31 and 501 during transfer into and out of the unit represent the primary source of contamination at IHSS 204. If releases from the primary sources at IHSS 204 impacted environmental media outside of the building, then the contaminated environmental media (e.g., soil) would be considered a secondary contaminant source.

At IHSS 217, the primary source of contamination includes the 4-liter bottle(s) that contained neutralized cyanide waste, the laboratory table, and the fume hood. Again, if releases from the primary source at IHSS 217 impacted environmental media outside of the building, then the contaminated environmental media (e.g., soil) would be considered a secondary contaminant source.

2.5.1.1 Source Characteristics

The IHSSs comprising OU15 are described in detail in Section 2.2. As discussed in Section 2.4, no historical releases to the ground surface and/or beneath the buildings are believed to have occurred within OU15. Therefore potentially contaminated media outside of OU15 buildings, such as soils, are not considered to be current contaminant sources.

2.5.1.2 Contaminant Characteristics

The characteristics of wastes associated with OU15 IHSSs are addressed in Section 2.4. At the four drum storage areas, a variety of wastes are potential contaminants. At IHSS 178, VOCs, and, possibly, radioactive wastes were stored in drums. At IHSS 179, oils, chlorinated solvents, radioactive wastes, and possibly beryllium were stored in drums. At IHSS 180, VOCs, beryllium, and radioactive wastes were stored in drums along with oils contaminated with other organic compounds and uranium. A variety of solid and liquid wastes were present within IHSS 211. These wastes include VOCs, metals, and low-level radioactive mixed wastes contaminated with uranium-238. At IHSS 204, the Original Uranium Chip Roaster, potential contaminants consist of uranium chips coated with oil and organic solvents. At IHSS 217, the waste material contained within the 4-liter bottle(s) was cyanide. Cyanide also potentially contaminated the laboratory table and fume hood with cyanide.

No analytical results from environmental media that may have been contaminated by primary sources within OU15 IHSSs currently exist, and it is not possible to characterize secondary contaminant sources at this time. However, as mentioned previously, no historical releases to the ground surface and/or beneath the buildings are believed to have occurred from the IHSSs within OU15 because (1) no releases have been documented and (2) secondary containment systems (including the buildings themselves) would have prevented releases to environmental media outside of the buildings. Section 7.2.2 provides the rationale for selecting contaminants of concern for the OU15 Field Sampling Plan.

2.5.2 Release Mechanisms and Transport Pathways

The primary release mechanisms for the drum storage areas in IHSSs 178, 179, 180, 204 (Rooms 31 and 501), 211, and 217 are leaks, spills, and other accidental releases from drums. Secondary release mechanisms at these IHSSs depend on the physical and chemical properties of the wastes and include "runoff," leaching, volatilization, and tracking. Release mechanisms for liquid wastes include surface "runoff" along drum containers, floors, walls, cracks, etc. and leaching of spilled liquids into building materials. Volatilization of liquid wastes and airborne dispersion of contaminated solids (i.e., dust/particulates) may have also occurred at these IHSSs assuming a release from the drums. Additionally, wastes can be tracked outside of the IHSS by humans and machinery resulting in dispersion of contaminants within the building and potentially, to outside areas.

The primary release mechanism for the Original Uranium Chip Roaster, IHSS 204, is also spills and leaks. Secondary release mechanisms at IHSS 204 include volatilization, air dispersion, inside building "runoff," leaching into building materials, and tracking. On June 28, 1985, the area around the Original Uranium Chip Roaster was flooded with water during a fire. Secondary release of contaminants may have occurred at this time by suspension and/or dissolution in water and subsequent transport by runoff outside of the IHSS.

At IHSS 217, the primary release mechanisms are spills, leaks, and volatilization from the 4-liter bottle(s). Potential leaks and spills were likely contained within the laboratory table/hood structure. However, assuming that the containment structure overflowed, secondary release may have occurred by airborne dispersion, "runoff," leaching into building materials, and tracking.

Potential release pathways from the IHSSs to other rooms inside the building or outside areas are illustrated in Figure 2-7. Included among these pathways, or transport mechanisms, are (1) surface runoff to drains and cracks with possible leaching into the building materials/structure and subsequent infiltration to soils outside of the buildings, (2) surface runoff to inside areas where protective surface coatings are damaged or not present with leaching into building materials/structures and possible infiltration to soils outside of the buildings, (3) overflow of bermed areas and surface runoff to other rooms inside the buildings and subsequent infiltration to soils outside of the buildings, and (4) tracking by humans and machinery throughout the buildings.

Historical accounts of OU15 releases (Section 2.4.2) indicate that no known releases have occurred at any of the IHSS except IHSS 204. Therefore the potential for impact of environmental media is considered low.

2.5.3 Exposure Routes and Receptors

As illustrated in Figures 2-6 and 2-7, contaminants released from OU15 can affect potential receptors through inhalation of airborne particles or vapors and through ingestion of or dermal contact with contaminated source or transport media. Potential human receptors include RFP workers and visitors to the site. Environmental receptors include biota (both flora and fauna) indigenous to the OU15 environs. However, environmental receptors within OU15 are considered to be non-existent as mentioned in Section 1.3.3.5 and discussed further in Section 9.0. Because of the location of the OU15 and the nature of the known releases from it, it is reasonable to conclude that contamination from OU15 will not affect offsite populations before characterization and any necessary remediation are performed under the IAG.

2.5.4 Exposure Pathway Summary

One of the primary goals of the OU15 RFI/RI is to gather data to support a Baseline Risk Assessment, which evaluates the potential risks of OU15 contamination to human health and the environment. The elements of the site conceptual model for OU15 described above are shown in Figures 2-6 and 2-7, which depict sources of contamination, mechanisms of contaminant release, potential contaminant migration pathways, and receptors. The model as pictured is based on an initial evaluation of preliminary data. As additional information is obtained, the overall model and specific portions of the model may be refined or expanded to address the issues of concern.

The OU15 conceptual model developed in the preceding sections identifies potential completed exposure pathways resulting from OU15 releases. The pathways listed below are derived from the completed exposure pathways illustrated in the conceptual model flow chart (Figure 2-6). The analyses describe how each of the listed pathways will be evaluated under the Phase I RFI/RI for OU15.

TABLE 2-1

TYPICAL COMPONENTS OF DRUMS STORED IN IHSS 178, BUILDING 881-DRUM STORAGE AREA

(Rockwell International, 1988)

Sample Identification	Total Alpha (pCi/L)	Beryllium (ug/ml)	Components
Samples Taken November 8, 1983			
68	0±70	<0.1	(1)
69	11±96	<0.1	
70	59±86	<0.1	
Samples Taken April 8, 1986			
308			Freon TF
309			Freon TF 1,1,1-Trichloroethane
Samples Taken July 18, 1986			
330	8,800±1,400	<0.1	Freon TF
331	1,900±100	<0.1	Freon TF Carbon dioxide
332	840±90	<0.1	Freon TF Carbon dioxide
Samples Taken August 8, 1986			
345	5,900±1,000	<0.1	Water Freon TF
346	5,400±1,300	<0.10	Freon TF (<1.0% by volume)

Note: (1) Blanks indicate analysis for components or a specific parameter was not conducted.

TABLE 2-2

TYPICAL COMPONENTS OF DRUMS STORED IN IHSS 179, *BUILDING 865-DRUM STORAGE AREA*

(Rockwell International, 1986)

Sample Identification	Total Alpha (pCi/L)	Beryllium (ug/g)	Components
Samples Taken May 2, 1986			
320	3,600±0	0.21	1,1,1-Trichloroethane (<0.1 by volume) Freon TF (<0.1% by volume) Carbon dioxide
321	4,400±600	0.40	1,1,1-Trichloroethane (<0.1% by volume) Carbon dioxide
Samples Taken July 10, 1986			
333	7,000±1,400	3.9	(1)
334	2,600±300	0.35	
335	1,400±600	1.7	
336	3,800±600	<0.1	
337	120,000±0	0.51	

Note: (1) Blanks indicate components not analyzed for.

TABLE 2-3

TYPICAL COMPONENTS OF DRUMS STORED IN IHSS 180, BUILDING 883-DRUM STORAGE AREA

(Rockwell International, 1986)

Sample Identification	Total Alpha (pCi/L)	Beryllium (ug/g)	Components
Samples Taken February 7, 1986			
290	2,300±600	<.10	(1)
291	1,200±500	<.10	
292	1,600±600	<.10	
293	38,000±0	<.10	
294	4,700±1,500	<.10	
295	1,100±100	<.10	
296	280±70	<.10	
297	3,600±900	<.10	
298	540±80	<.10	
299	670±80	<.10	
300	88,000±20,000	<.10	
301	90,000±8,000	<.10	
302	36,000±9,000	<.10	
303	3,700±1,600	.15	
304	4,800±1,700	<.10	
Samples Taken March 18, 1986			
1			Carbon dioxide
2			Carbon dioxide 1,1,1-Trichloroethane
5			Freon 1,1,1-Trichloroethane
15			Carbon dioxide Freon TF 1,1,1-Trichloroethane
Samples Taken May 7, 1986			
322	8,400±400	<.10	
323	110±70	<.10	
324	23,000±13,000	<.10	
325	3,300±200	<.10	

TABLE 2-3 (continued)

TYPICAL COMPONENTS OF DRUM SAMPLES FROM IHSS 180, BUILDING 883-DRUM STORAGE AREA

(Rockwell International, 1986)

Sample Identification	Total Alpha (pCi/L)	Beryllium (ug/g)	Components
Samples Taken July 17, 1986			
327	310±60	<0.10	Freon TF (<0.1% by volume) Carbon dioxide
328	280±20		Freon TF (<0.1% by volume)
Samples Taken July 18, 1986			
330	8,800±1,400	<0.10	Freon TF
331	1,900±100	<0.10	Freon TF Carbon dioxide
332	840±90	<0.10	Freon TF Carbon dioxide

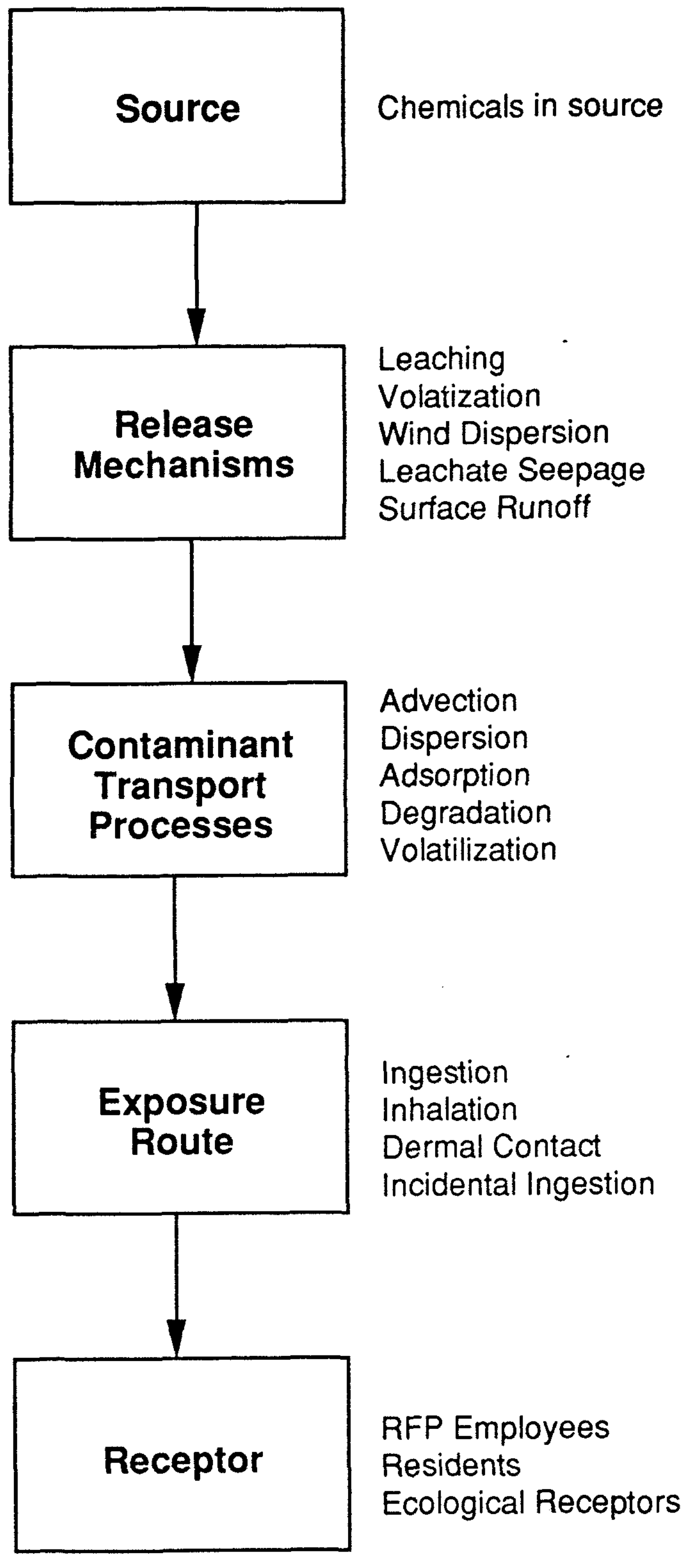
Note: (1) Blanks indicate analysis for components or a specific parameter was not conducted.

TABLE 2-4

WASTES APPROVED FOR STORAGE IN IHSS 211, UNIT 26,
BUILDING 881-DRUM STORAGE AREA

DESCRIPTION	*WASTE STREAM IDENTIFICATION NUMBER
Waste Resin	03240
Planchets	03250
Solid Waste	03300
Solid Waste	03320
Solid Waste	03410
Solid Waste	03450
Solid Waste	03480
Solid Waste	03770
Stainless Steel, Titanium, & Niobium oxide	04410
Used Graphite Electrodes	04420
Solid Waste	04460
Crucibles	04510
Dirty Kimwipes	04760
Solid Wastes	05450
Kimwipes	05490
Filter Residue	05500
Used Filter Media	05570

* RCRA Part B Operating Permit Application for U.S. Department of Energy - Rocky Flats Plant Hazardous and Low Level Mixed Wastes (December 15, 1987).

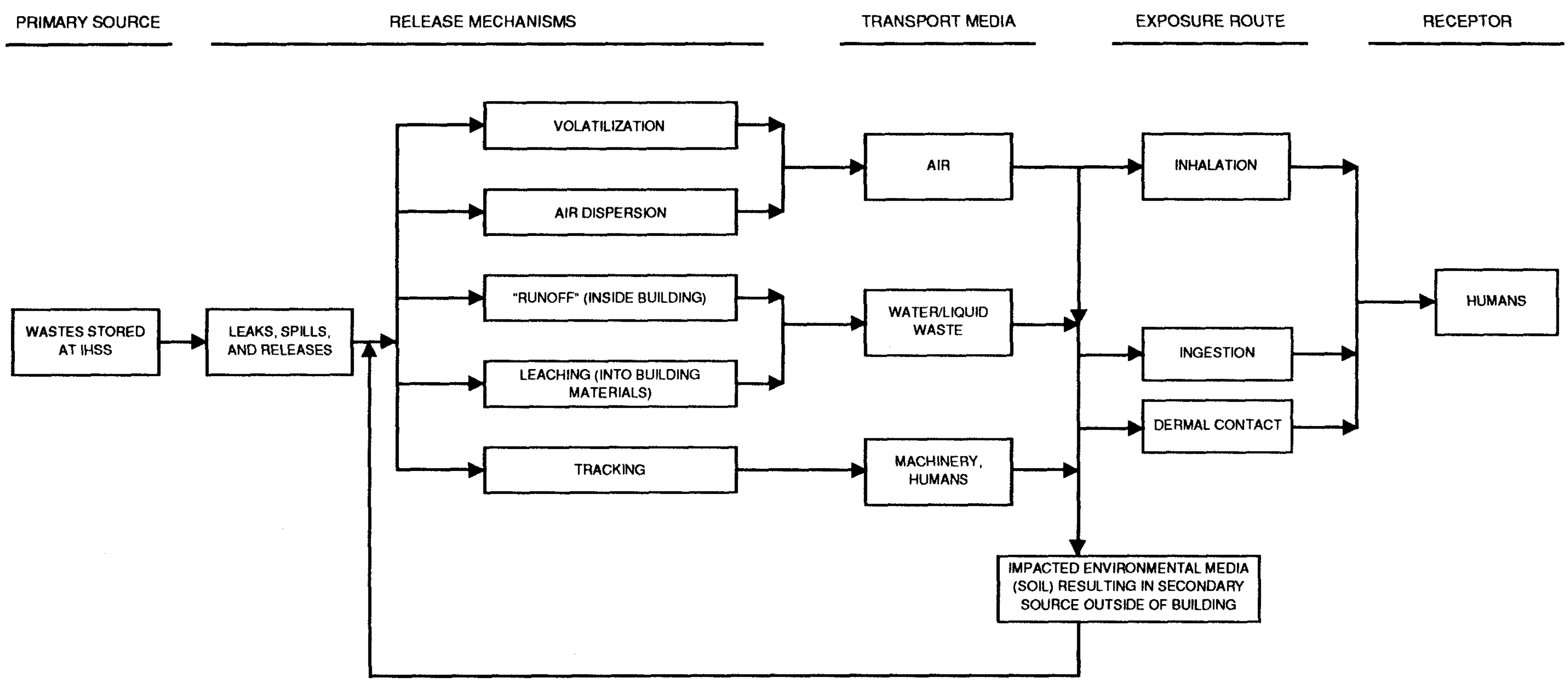


Generic Site Conceptual Model

Figure 2-5

M65\ES\Generic Site.MDW\04-28

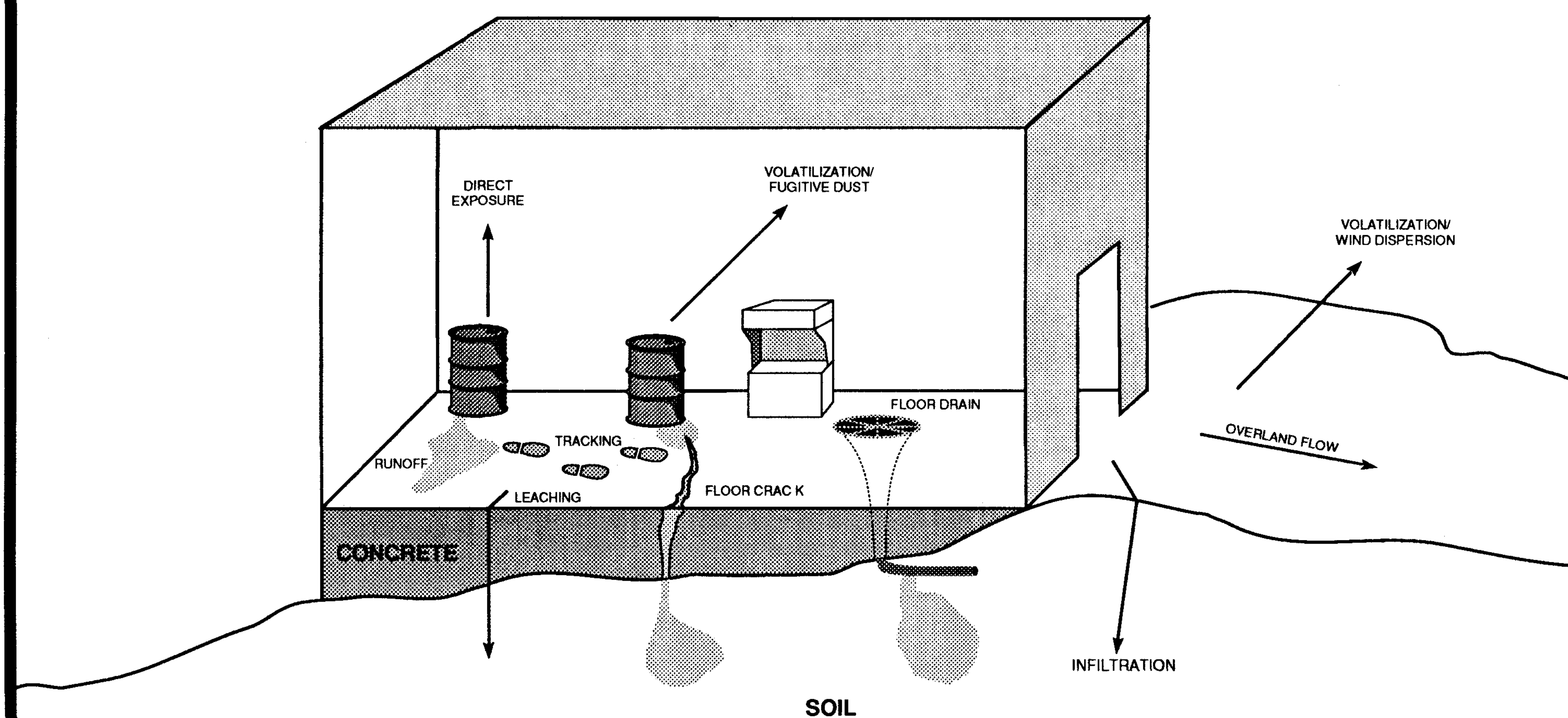
OU15 CONCEPTUAL MODEL



Conceptual Model Flow Chart for Inside Building Exposure Pathway -- OU15, Rocky Flats Plant

Figure 2-6

M53E\ES\Concept Model OU15.mdw\4-30



Conceptual Model for
Inside Building Closure – OU15, Rocky Flats Plant
Figure 2-7

M53E\ES\Concept Mod OU15-drwng.ill\4-30

Approved by:

____________________ __/__/__ ____________________ __/__/__

Manager, Remediation Programs RFI Project Manager

3.0 ROCKY FLATS PLANT CHEMICAL-SPECIFIC BENCHMARKS

Tables 3.1 through 3.4 provide a preliminary identification of potential chemical-specific Benchmarks for ground water and surface water at the Rocky Flats Plant. Chemical-specific Benchmarks for soil have not been developed at this time. EPA analytical methods and detection limits have been specified for soil analyses to obtain data of the highest quality with the lowest possible detection limits. The Benchmarks included in this section are in lieu of ARARs, and were developed for the entire Rocky Flats Plant site and are not specific to OU15. Site-specific ARARs will be developed as the initial step of the Corrective Measures Study (if required) for OU15. As validated data become available from the OU15 Phase I RFI/RI, the Benchmarks will be reevaluated in accordance with Chapter Three, Part 15 of the IAG (U.S. DOE, 1991a). The site wide Benchmarks includes in this work plan are not intended for use in establishing clean up goals, however, they will be used to establish RFI/RI analytical detection limits. Cleanup criteria for OU15 will be site specific and shall be based on results of an environmental and human-based Risk Assessment.

Sitewide Benchmarks represented in Tables 3.1 through 3.4 were developed from the following sources:

- Colorado Department of Health (CDH, Water Quality Control Commission (WQCC), ground water standards (EG&G, 1991e);

- Safe Drinking Water Act (SWADA), Maximum Contaminant Levels (MCLs), surface water and ground water (EG&G, 1991e);

- Clean Water Act (CWA), Ambient Water Quality Criteria (AWQC), potentially applicable to surface water and ground water (EG&G, 1991e);

- RCRA, Subpart F, Ground Water Concentration Limits (40 CFR 264.94), ground water standards (EG&G, 1991e); and

- CDH, WQCC proposed statewide and classified ground water area standards (EG&G, 1991e).

In instances where Benchmarks have not been proposed for a particular chemical or for a particular type of investigation method, EG&G's General Radiochemistry and Routine Analytical Services Protocol (GRRASP) protocol or other appropriate laboratory procedures will be considered as the practical quantitation limits and will be applied (EG&G, 1991d).

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Bicarbonate	A	10,000		E310.1											
Carbonate	A	10,000		E310.1											
Chloride	A	5,000		E325	250,000 *							250,000			
Chlorine	A	1,000		E4500											
Fluoride	A	5,000		E340	4,000; 2,000*		4,000				4,000		2,000		
N as Nitrate	A	5,000		E353.1	10,000			10,000			10,000				
N as Nitrate+Nitrite	A	5,000		E353.1		10,000		10,000					100,000		
N as Nitrite	A	5,000		E354.1		1,000		1,000			1,000		10,000		
Sulfate	A	5,000		E375.4	250,000*							250,000			
Sulfide	A														
Coliform (total)	B	1		SM9221C	1/100 ml						1/100 ml				
Ammonia as N	C	5,000		E350											
Dioxin	D		0.01(9)	d						0.00000022					0.000000013
Sulfur	E	100,000		E600											
Dissolved Oxygen	FP	500		SM4500											
pH	FP	0.1		E150.1	6.5-8.5 *							6.5-8.5	6.5-8.5		
Specific Conductance	FP	1		E120.1											
Temperature	FP														
Boron	I	5,000		E6010									750		
Total Dissolved Solids	I	10,000		E160.1	500,000*									400,000 (1)	
Aluminum	M	200		CT		50 to 200*							5,000		
Antimony	M	60		CT											
Arsenic	M	10		CT	50				50		50		100		
Arsenic III	M														
Arsenic V	M														
Barium	M	200		CT	1,000	2,000 (e)		2,000 (e)	1,000		1,000				

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
		PQL MDL			SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Parameter	Type (5)	RFP	CDH	Method (6)											
Beryllium	M	5		CT									100		
Cadmium	M	5		CT	10	5		5	10		10		10		
Calcium	M	5,000		CT											
Cesium	M	1,000		NC											
Chromium	M	10		CT	50	100		100	50		50		100		
Chromium III	M	5		SW8467196											
Chromium VI	M	10		E218.5											
Cobalt	M	50		CT									50		
Copper	M	25		CT	1,000 *			1,300 (f)				1,000	200		
Cyanide	M	10		CT							200				
Iron	M	100		CT	300 *							300	5,000		
Lead	M	5		CT	50			0 (f)	50		50		100		
Lithium	M	100		NC									2,500		
Magnesium	M	5000		CT											
Manganese	M	15		CT	50 *							50	200		
Mercury	M	0.2		CT	2	2		2	2		2		10		
Molybdenum	M	200		NC											
Nickel	M	40		CT									200		
Potassium	M	5000		CT											
Selenium	M	5		CT	10	50		50	10		10		20		
Silver	M	10		CT	50	100 *			50		50				
Sodium	M	5000		CT											
Strontium	M	200		NC											
Thallium	M	10		CT											
Tin	M	200		NC											
Titanium	M	10		E6010											
Tungsten	M	10		E6010											
Vanadium	M	50		CT									100		
Zinc	M	20		CT	5,000 *							5,000	2,000		

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
2,4,5-TP Silvex	P		0.5	d	10	50		50	10	50					
2,4-Dichlorophenoxyacetic Acid	P		1	d	100	70		70	100	70					
(2,4-D)	P														
Acrolein	P		10												
Aldicarb	P		10			3 (e)		1 (e)		10					
Aldrin	P	0.05	0.1	CP						0.002					0.000074
Bromacil	P														
Carbofuran	P			d		40		40		36					
Chloranil	P														
Chlordane (Alpha)	P	0.5	1	CP		2		0		0.03					0.00046
Chlordane (Gamma)	P	0.5	1	CP		2		0		0.03					0.00046
Chlorpyrifos	P			E619											
DDT	P	0.1	0.1	CP						0.1					0.000024
DDT Metabolite (DDD)	P	0.1		CP											
DDT Metabolite (DDE)	P	0.1	0.1	CP						0.1					
Demeton	P														
Diazinon	P														
Dieldrin	P	0.1	0.1	CP						0.002					0.000071
Endosulfan I	P	0.05		CP											
Endosulfan II	P	0.1		CP											
Endosulfan sulfate	P	0.1		CP											
Endrin	P	0.1	0.1	CP	0.2				0.2	0.2					
Endrin Aldehyde	P		0.1							0.2					
Endrin Ketone	P	0.1		CP											
Guthion	P														
Heptachlor	P	0.05	0.05	CP		0.4		0		0.008					0.00028
Heptachlor Epoxide	P	0.05	0.05	CP		0.2		0		0.09					
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP						0.006					0.0092

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Hexachlorocyclohexane, Beta	P	0.05	0.1(9)	CP											0.0163
Hexachlorocyclohexane, BHC	P		0.05												
Hexachlorocyclohexane, Delta	P	0.05		CP											
Hexachlorocyclohexane, Tech	P		0.5(9)	f											0.0123
Hexachlorocyclohexane, Lindane	P	0.05	0.05	CP	4	0.2		0.2	4.0	0.2					0.0186
Malathion	P														
Methoxychlor	P	0.5	0.5	CP	100	40		40	100	40	100				
Mirex	P														
Parathion	P														
PCBs	P	0.5	1	CP		0.5		0		0.005					0.000079
Simazine	P			e											4
Toxaphene	P	1	5	CP		3		0	5.0	0.03	5				
Vaponite 2	P														
Aroclor 1016	PP	0.5		CP											
Aroclor 1221	PP	0.5		CP											
Aroclor 1232	PP	0.5		CP											
Aroclor 1242	PP	0.5		CP											
Aroclor 1248	PP	0.5		CP											
Aroclor 1254	PP	1		CP											
Aroclor 1260	PP	1		CP											
Atrazine	PP		1 (9)	e		3		3							3
Americium (pCi/l)	R														
Americium 241 (pCi/l)	R	0.01													
Cesium 134 (pCi/l)	R	1								80 (2)					
Cesium 137 (pCi/l)	R	1													
Gross Alpha (pCi/l)	R	2			15 (8)						15(8)				
Gross Beta (pCi/l)	R	4			50 (4 mrem/yr)						4 mrem/yr				
Plutonium (pCi/l)	R														

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Plutonium 238+239+240 (pCi/l)	R	0.01								15 (2)					
Radium 226+228 (pCi/l)	R	0.5/1.0 (4)			5					5 (2)					
Strontium 89+90 (pCi/l)	R	1													
Strontium 90 (pCi/l)	R				8 (3)					8 (2)					
Thorium 230+232 (pCi/l)	R									60 (2)					
Tritium (pCi/l)	R				20,000 (3)					20,000 (2)					
Uranium 233+234 (pCi/l)	R														
Uranium 235 (pCi/l)	R	0.6													
Uranium 238 (pCi/l)	R	0.6													
Uranium (Total) (pCi/l)	R														
1,2,4,5-Tetrachlorobenzene	SV		10	b						2					
1,2,4-Trichlorobenzene	SV	10		CS											
1,2-Dichlorobenzene (Ortho)	SV	10	1	CS		600		600		620					
1,2-Diphenylhydrazine	SV			b						0.05					
1,3-Dichlorobenzene (Meta)	SV	10	1	CS						620					
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75		75			75					
2,4,5-Trichlorophenol	SV	50		CS						700					
2,4,6-Trichlorophenol	SV	10	50	CS						2					1.2
2,4-Dichlorophenol	SV	10	50	CS						21					
2,4-Dimethylphenol	SV	10		CS											
2,4-Dinitrophenol	SV	50	50	CS						14					
2,4-Dinitrotoluene	SV	10		CS											
2,6-Dinitrotoluene	SV	10		CS											
2-Chloronaphthalene	SV	10		CS											
2-Chlorophenol	SV	10		CS											
2-Methylnaphthalene	SV	10		CS											
2-Methylphenol	SV	10		CS											
2-Nitroaniline	SV	50		CS											

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
		PQL MDL								CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	RFP	CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
2-Nitrophenol	SV	10		CS											
3,3-Dichlorobenzidine	SV	20		CS											
3-Nitroaniline	SV	50		CS											
4,6-Dinitro-2-methylphenol	SV	50		CS											
4-Bromophenyl Phenylether	SV	10		CS											
4-Chloroaniline	SV	10		CS											
4-Chlorophenyl Phenyl Ether	SV	10		CS											
4-Chloro-3-methylphenol	SV	10		CS											
4-Methylphenol	SV	10		CS											
4-Nitroaniline	SV	50		CS											
4-Nitrophenol	SV	50		CS											
Acenaphthene	SV	10		CS											
Anthracene	SV	10		CS											
Benzidine	SV		10	d						0.0002	0.1				0.00012
Benzoic Acid	SV	50		CS											
Benzo(a)anthracene	SV	10		CS											
Benzo(a)pyrene	SV	10		CS											
Benzo(b)fluoranthene	SV	10		CS											
Benzo(g,h,i)perylene	SV	10		CS											
Benzo(k)fluoranthene	SV	10		CS											
Benzyl Alcohol	SV	10		CS											
bis(2-Chloroethoxy)methane	SV	10		CS											
bis(2-Chloroethyl)ether	SV	10		CS						0.03					0.0000037
bis(2-Chloroisopropyl)ether	SV	10		CS											
bis(2-Ethylhexyl)phthalate	SV	10		CS											
Butadiene	SV														
Butylbenzylphthalate	SV	10		CS											
Chlorinated Ethers	SV														
Chlorinated Napthalenes	SV														

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Chloroalkylethers	SV	10		CS											
Chlorophenol	SV										1				
Chrysene	SV	10		CS											
Dibenzofuran	SV	10		CS											
Dibenz(a,h)anthracene	SV	10		CS											
Dichlorobenzenes	SV														
Dichlorobenzidine	SV	20	10(9)	CS											0.01
Diethylphthalate	SV	10		CS											
Dimethylphthalate	SV	10		CS											
Di-n-butylphthalate	SV	10		CS											
Di-n-octylphthalate	SV	10		CS											
Ethylene Glycol	SV			d						7,000					
Fluoranthene	SV	10		CS											
Fluorene	SV	10		CS											
Formaldehyde	SV														
Haloethers	SV														
Hexachlorobenzene	SV	10	10	CS						6					0.00072
Hexachlorobutadiene	SV	10	10	CS						1					0.45
Hexachlorocyclopentadiene	SV	10		CS						49					
Hexachloroethane	SV	10		CS											1.9
Hydrazine	SV														
Indeno(1,2,3-cd)pyrene	SV	10		CS											
Isophorone	SV	10	10	CS						1,050					
Naphthalene	SV	10		CS											
Nitrobenzene	SV	10	10	CS						3.5					
Nitrophenols	SV														
Nitrosamines	SV		10												
Nitrosodibutylamine	SV			b											0.0064
Nitrosodiethylamine	SV		10	b											0.0008

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) GROUND WATER QUALITY STANDARDS (ug/l)

		PQL MDL			FEDERAL STANDARDS					STATE STANDARDS: CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	RFP	CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Nitrosodimethylamine	SV		10	b											0.0014
Nitrosopyrrolidine	SV		10	b											0.016
N-Nitrosodiphenylamine	SV	10	10(9)	CSb											4.9
N-Nitroso-di-n-dipropylamine	SV	10		CSb											
Pentachlorinated Ethanes	SV			b											
Pentachlorobenzene	SV		10	b						6 (7)					
Pentachlorophenol	SV	50	50	CS		1 (e)		0 (e)		200					
Phenanthrene	SV	10		CS											
Phenol	SV	10		CS							1				
Phthalate Esters	SV														
Polynuclear Aromatic Hydrocarb	SV		1 (9)	b											0.0028
Vinyl Chloride	SV	10	2	CV	2		0			2					
1,1,1-Trichloroethane	V	5	1	CV	200		200			200					
1,1,2,2-Tetrachloroethane	V	5	1 (9)	CV											0.17
1,1,2-Trichloroethane	V	5	1	CV						3					0.6
1,1-Dichloroethane	V	5		CV											
1,1-Dichloroethene	V	5	1	CV	7		7			7					
1,2-Dichloroethane	V	5	1	CV	5		0			0.4					
1,2-Dichloroethene (cis)	V		1	a		70		70		70					
1,2-Dichloroethene (total)	V	5		CV											
1,2-Dichloroethene (trans)	V		1	a		100		100		100					
1,2-Dichloropropane	V	5	1	CV		5		0		0.56					
1,3-Dichloropropene (cis)	V	5		CV											
1,3-Dichloropropene (trans)	V	5		CV											
2-Butanone	V	10		CV											
2-Hexanone	V	10		CV											
4-Methyl-2-pentanone	V	10		CV											
Acetone	V	10		CV											

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic
Acrylonitrile	V		15(9)	c											0.058
Benzene	V	5	1	CV	5		0			1					
Bromodichloromethane	V	5	1	CV						0.3					
Bromoform	V	5	1	CV						4					
Bromomethane	V	10		CV											
Carbon Disulfide	V	5		CV											
Carbon Tetrachloride	V	5	1	CV	5		0			0.3					
Chlorinated Benzenes	V	10		CV/CS											
Chlorobenzene	V	5	1	CV/CS		100		100		100					
Chloroethane	V	10		CV											
Chloroform	V	5	1	CV	Tot THM <100**					6					0.19
Chloromethane	V	10		CV											
Dibromochloromethane	V	5	1	CV						14					
Dichloroethenes	V														
Ethyl Benzene	V	5	1	CV		700		700		680					
Ethylene Dibromide	V			d		0.05		0		0.0004					
Ethylene Oxide	V														
Halomethanes	V		1 (9)		100					100					0.19
Methylene Chloride	V	5		CV											
Pyrene	V	10		CS											
Styrene	V	5		CV		100		100							
Tetrachloroethanes	V	5		CV											
Tetrachloroethene	V	5	1	CV		5		0		5					0.8
Toluene	V	5	1	CV		1,000		1,000		1,000					
Trichloroethanes	V	5		CV											
Trichloroethene	V	5	1	CV	5		0			5					
Vinyl Acetate	V	10		CV											
Xylenes (total)	V	5		CV		10,000		10,000							

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
GROUND WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	FEDERAL STANDARDS SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	STATE STANDARDS CDH CWQCC Groundwater Quality Standards (d) Statewide Table A (d) (7)	Site-Specific (g) Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic

EXPLANATION OF TABLE

* = secondary maximum contaminant level

** = total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane

CDH = Colorado Department of Health
CLP = Contract Laboratory Program
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
PQL = Practical Quantitation Limit
RCRA = Resource Conservation and Recovery Act
RFP = Rocky Flats Plant
SDWA = Safe Drinking Water Act
TAL = Target Analyte List
THM = Total Trihalomethanes
TIC = Tentatively Identified Compound
MDL = Minimum Detection Limit for radionuclides (pCi/l)
ug/l = micrograms per liter
VOA = Volatile Organic Analysis
CWQC = Colorado Water Quality Control Commission

(1) TDS standard - see Table 4 in (d); standard is 400 mg/l or 1.25 times the background level, whichever is least restrictive
(2) radionuclide standards - see sec. 3.11.5(c)2 in (d)
(3) If both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr.
(4) MDL for Radium 226 is 0.5; MDL for radium 228 is 1
(5) type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; I=indicator; M=metal; P=pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(6) method abbreviations are: CT=CLP-TAL; NC=non-CLP; CV=CLP-VOA; CS=CLP-SEMI; EP=EPA-PEST; CP=CLP-PEST; E=EPA; a = detected as total in CV; b = detected as TICs in CS; c = detected as TIC in CV; d = not routinely monitored; e = monitored in discharge ponds; f = mixture-individual isomers detected.

TABLE 3-1. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) GROUND WATER QUALITY STANDARDS (ug/l)

					FEDERAL STANDARDS					STATE STANDARDS					
										CDH CWQCC Groundwater Quality Standards (d)					
										Statewide	Site-Specific (g)				
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	RCRA Subpart F Limit (c)	Table A (d) (7)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic

(7) Where standard is below (more stringent than) PQL (CDH), PQL is standard.

(8) Value for gross alpha excludes uranium.

(9) Value is CDH detection level (PQL not available)

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of 5/1990)

(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective July 30, 1992 (56 Federal Register 3526; 1/30/1991)

(c) NCP, 40 CFR 300; NCP Preamble 55 FR 8764; CERCLA Compliance with Other Laws Manual, EPA/540/G-89/006, August 1988, 40 CFR 264.94.

(d) CDH/Colorado Water Quality Control Commission, The Basic Standards for Ground Water, 3.11.0 (5 CCR 1002-8) 1/5/1987 amended 11/30/1991; statewide radioactive standards listed in 3.11.5(c)(2).

(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective January 1, 1993 (56 FR 30266; 7/1/1991)

(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/91) effective 12/7/92.

(g) CDH/Colorado Water Quality Control Commission, Classifications and Water Quality Standards for Ground Water, 3.12.0 (9/19/1991).

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Bicarbonate	A	10,000		E310.1									
Carbonate	A	10,000		E310.1									
Chloride	A	5,000		E325	250,000*				860,000(e)	230,000(e)			
Chlorine	A	1,000		E4500					19	11			
Flouride	A	5,000		E340	4,000; 2,000*		4,000					4,000	
N as Nitrate	A	5,000		E353.1	10,000			10,000			10,000		
N as Nitrate+Nitrite	A	5,000		E353.1		10,000		10,000					
N as Nitrite	A	5,000		E354.1		1,000		1,000					
Sulfate	A	5,000		E375.4	250,000*								
Sulfide	A												
Coliform (Fecal)	B	1		SM9221C	1/100 ml								
Ammonia as N	C	5,000		E350					Criteria are pH and temperature dependent – see criteria document				
Dioxin	D			d					0.01	0.00001	0.000000013	0.000000014	
Sulfur	E	100,000		E600									
Dissolved Oxygen	FP	500		SM4500					5,000				
pH	FP	0.1		E150.1	6.5–8.5 *					6.5–9			
Specific Conductance	FP	1		E120.1									
Temperature	FP								SS	SS			
Boron	I	5,000		E6010									
Total Dissolved Solids	I	10,000		E160.1	500,000*				SS	SS	250,000		
Aluminum	M	200		CT		50 to 200*			750	87			
Antimony	M	50		CT					9,000	1,600	146	45,000	
Arsenic	M	10		CT	50						0.0022	0.0175	
Arsenic III	M								360	190			
Arsenic V	M								850	48			
Barium	M	200		CT	1,000	2,000 (f)		2,000 (f)			1,000		
Beryllium	M	5		CT					130	5.3	.0068**	.117**	

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	Fish Consumption Only	NRC Effluent Standards Water pCi/L
Cadmium	M	5		CT	10	5		5	3.9 (3)	1.1 (3)	10		
Calcium	M	5,000		CT									
Cesium	M	1,000		NC									
Chromium	M	10		CT	50	100		100					
Chromium III	M	5		SW8467196					1,700	210	170,000	3,433,000	
Chromium VI	M	10		E218.5					16	11	50		
Cobalt	M	50		CT									
Copper	M	25		CT	1,000*			1,300 (g)	18 (3)	12 (3)			
Cyanide	M	10		CT					22	5.2	200		
Iron	M	100		CT	300 *					1,000	300		
Lead	M	5		CT	50			0 (g)	82 (3)	3.2 (3)	50		
Lithium	M	100		NC									
Magnesium	M	5000		CT									
Manganese	M	15		CT	50 *						50	100	
Mercury	M	0.2		CT	2	2		2	2.4	0.012	0.144	0.146	
Molybdenum	M	200		NC									
Nickel	M	40		CT					1,400 (3)	160 (3)	13.4	100	
Potassium	M	5000		CT									
Selenium	M	5		CT	10	50		50	20 (d)	5 (d)	10		
Silver	M	10		CT	50	100 *			4.1 (3)	0.12	50		
Sodium	M	5000		CT									
Strontium	M	200		NC									
Thallium	M	10		CT					1,400 (1)	40 (1)	13	48	
Tin	M	200		NC									
Titanium	M	10		E6010									
Tungsten	M	10		E6010									
Vanadium	M	50		CT									
Zinc	M	20		CT	5,000 *				120 (3)	110 (3)			

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

		PQL			SDWA	SDWA	SDWA	SDWA	CWA		CWA		NRC
		MDL			Maximum Contaminant Levels (a)	Maximum Contaminant Levels (b)	Maximum Contaminant Level Goals (a)	Maximum Contaminant Level Goals (b)	AWQC for Protection of Aquatic Life (c)		AWQC for Protection of Human Health (c)		Effluent Standards
Parameter	Type (7)	RFP	CDH	Method (8)					Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only	Water pCi/L
2,4,5-TP Silvex	P		0.5	d	10	50		50					
2,4-Dichlorophenoxyacetic Acid (2,4-D)	P		1	d	100	70		70					
Acrolein	P		10						68(1)	21(1)	320	780	
Aldicarb	P		10			3 (f)		1 (f)					
Aldrin	P	0.05	0.1	CP					3.0		0.000074	0.000079	
Bromacil	P												
Carbofuran	P			d		40		40					
Chloranil													
Chlordane (Alpha)	P	0.5	1	CP		2		0	2.4	0.0043	0.00046	0.00048	
Chlordane (Gamma)	P	0.5	1	CP		2		0	2.4	0.0043	0.00046	0.00048	
Chlorpyrifos	P		0.1	E619					0.063	0.041			
DDT	P	0.1	0.1	CP					1.1	0.0011	0.000024	0.000024	
DDT metabolite (DDD)	P	0.1	0.1	CP					0.06				
DDT metabolite (DDE)	P	0.1	0.1	CP					1,050				
Demeton	P		1							0.1			
Diazinon	P												
Dieldrin	P	0.1	0.1	CP					2.5	0.0019	0.00007	0.000076	
Endosulfan I	P	0.05	0.1	CP					0.22	0.056	74	159	
Endosulfan II	P	0.1	0.1	CP									
Endosulfan Sulfate	P	0.1	0.1	CP									
Endrin	P	0.1	0.1	CP	0.2				0.18	0.0023	1		
Endrin Aldehyde	P		0.1										
Endrin Ketone	P	0.1		CP									
Guthion	P		1.5							0.01			
Heptachlor	P	0.05	0.05	CP		0.4		0	0.52	0.0038	0.00028	0.00029	
Heptachlor Epoxide	P	0.05	0.05	CP		0.2		0					
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP							0.0092	0.031	
Hexachlorocyclohexane, Beta	P	0.05	0.05	CP							0.0163	0.0547	
Hexachlorocyclohexane, BHC	P	0.05	0.05										

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Hexachlorocyclohexane, Delta	P	0.05		CP									
Hexachlorocyclohexane, Technical	P		0.2	f							0.0123	0.0414	
Hexachlorocyclohexane, (Lindane) Gama	P	0.05	0.05	CP	4	0.2		0.2	2.0	0.08			
Malathion	P		0.2							0.01			
Methoxychlor	P	0.5	0.5	CP	100	40		40		0.03	100		
Mirex	P		0.1							0.001			
Parathion	P								0.065	0.013			
PCBs	P	0.5	!	CP		0.5		0	2 0	0.014	0.000079**	0.000079**	
Simazine	P			e									
Toxaphene	P	1	5	CP		3		0	0.73	0.0002	0.00071**	0.00073**	
Vaponite 2	P												
Aroclor 1016	PP	0.5		CP									
Aroclor 1221	PP	0.5		CP									
Aroclor 1232	PP	0.5		CP									
Aroclor 1242	PP	0.5		CP									
Aroclor 1248	PP	0.5		CP									
Aroclor 1254	PP	1		CP									
Aroclor 1260	PP	1		CP									
Atrazine	PP			e		3		3					
Americium (pCi/l)	R												
Americium 241 (pCi/l)	R	0.01											20
Cesium 134 (pCi/l)	R	1											900
Cesium 137 (pCi/l)	R	1											1000
Gross Alpha (pCI/l)	R	2			15 (10)							15	
Gross Beta (pCi/l)	R	4			50 (4 mrem/yr)								
Plutonium (pCi/l)	R												
Plutonium 238+239+240 (pCi/l)	R	0.01											20
Radium 226+228 (pCi/l)	R	0.5/0.1 (9)			5							5	60

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	PQL MDL CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L
Strontium 89+90 (pCi/l)	R	1											500
Strontium 90 (pCi/l)	R				8 (6)							8	500
Thorium 230+232 (pCi/l)	R												30
Tritium (pCi/l)	R				20,000 (6)								1000000
Uranium 233+234 (pCi/l)	R												300
Uranium 235 (pCi/l)	R	0.6											300
Uranium 238 (pCi/l)	R	0.6											300
Uranium (total) (pCi/l)	R												
1,2,4,5-Tetrachlorobenzene	SV		10	b							38	48	
1,2,4-Trichlorobenzene	SV	10		CS									
1,2-Dichlorobenzene (Ortho)	SV	10	10	CS		600		600					
1,2-Diphenylhydrazine	SV			b					270 (1)				
1,3-Dichlorobenzene (Meta)	SV	10	1	CS									
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75		75						
2,4,5-Trichlorophenol	SV	50		CS							2,800		
2,4,6-Trichlorophenol	SV	10	50	CS						970 (1)	1.2 **	3.6 **	
2,4-Dichlorophenol	SV	10	50	CS					2,020 (1)	365 (1)	3,090		
2,4-Dimethylphenol	SV	10	50	CS					2,120 (1)				
2,4-Dinitrophenol	SV	50	50	CS									
2,4-Dinitrotoluene	SV	10	10	CS							0.11 **	9.1 **	
2,6-Dinitrotoluene	SV	10	10	CS					330 (1)	230 (1)	70	14,300	
2-Chloronaphthalene	SV	10		CS									
2-Chlorophenol	SV	10	50	CS					4,360 (1)	2,000 (1)			
2-Methylnaphthalene	SV	10		CS									
2-Methylphenol	SV	10		CS									
2-Nitroaniline	SV	50		CS									
2-Nitrophenol	SV	10		CS									
3,3-Dichlorobenzidine	SV	20	10	CS							0.01	0.02	

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

		PQL			SDWA	SDWA	SDWA	SDWA	CWA		CWA		NRC
		MDL			Maximum Contaminant Levels (a)	Maximum Contaminant Levels (b)	Maximum Contaminant Level Goals (a)	Maximum Contaminant Level Goals (b)	AWQC for Protection of Aquatic Life (c)		AWQC for Protection of Human Health (c)		Effluent Standards
Parameter	Type (7)	RFP	CDH	Method (8)					Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only	Water pCi/L
3-Nitroaniline	SV	50		CS									
4,6-Dinitro-2-methylphenol	SV	50	50	CS									
4-Bromophenyl Phenylether	SV	10		CS									
4-Chloroaniline	SV	10		CS									
4-Chlorophenyl Phenyl Ether	SV	10		CS									
4-Chloro-3-methylphenol	SV	10	50	CS					30 (1)				
4-Methylphenol	SV	10		CS									
4-Nitroaniline	SV	50		CS									
4-Nitrophenol	SV	50		CS					230 (1)	150 (1)			
Acenaphthene	SV	10	10	CS					1,700 (1)	520 (1)			
Anthracene	SV	10	1	CS									
Benzidine	SV		1	d					2,500		0.00012	0.00053	
Benzoic Acid	SV	50		CS									
Benzo(a)anthracene	SV	10	10	CS									
Benzo(a)pyrene	SV	10	10	CS									
Benzo(b)fluoranthene	SV	10	10	CS									
Benzo(g,h,i)perylene	SV	10	10	CS									
Benzo(k)fluoranthene	SV	10	10	CS									
Benzyl Alcohol	SV	10		CS									
bis(2-Chloroethoxy)methane	SV	10		CS									
bis(2-Chloroethyl)ether	SV	10	10	CS							0.03**	1.36 **	
bis(2-Chloroisopropyl)ether	SV	10	10	CS							34.7	4,360	
bis(2-Ethylhexyl)phthalate	SV	10	10	CS							15,000	50,000	
Butadiene	SV												
Butylbenzylphthalate	SV	10	10	CS									
Chlorinated Ethers	SV												
Chlorinated Napthalenes	SV								1,600 (1)				
Chloroalkylethers	SV	10		CS					238,000 (1)				
Chlorophenol	SV		50										

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	Fish Consumption Only	NRC Effluent Standards Water pCi/L
Chrysene	SV	10	10	CS									
Dibenzofuran	SV	10		CS									
Dibenz(a,h)anthracene	SV	10	10	CS									
Dichlorobenzenes	SV		1						1,120 (1)	763 (1)	400	2,600	
Dichlorobenzidine	SV	20	10	CS							0.01	0.02	
Diethylphthalate	SV	10	10	CS							350,000	1,800,000	
Dimethylphthalate	SV	10	10	CS							313,000	2,900,000	
Di-n-butylphthalate	SV	10	10	CS									
Di-n-octylphthalate	SV	10		CS									
Ethylene Glycol	SV			d									
Fluoranthene	SV	10	10	CS					3,980 (1)		42	54	
Fluorene	SV	10	10	CS									
Formaldehyde	SV												
Haloethers	SV								380 (1)	122 (1)			
Hexachlorobenzene	SV	10	10	CS							0.00072**	0.00074**	
Hexachlorobutadiene	SV	10	10	CS					90 (1)	9.3 (1)	0.45**	50 **	
Hexachlorocyclopentadiene	SV	10	10	CS					7 (1)	5.2 (1)	206		
Hexachloroethane	SV	10	10	CS					980 (1)	540 (1)	1.9	8.74	
Hydrazine	SV												
Indeno(1,2,3-cd)pyrene	SV	10	10	CS									
Isophorone	SV	10	10	CS					117,000 (1)		5,200	520,000	
Naphthalene	SV	10	10	CS					2,300 (1)	620 (1)			
Nitrobenzene	SV	10	10	CS					27,000 (1)		19,800		
Nitrophenols	SV								230 (1)	150 (1)			
Nitrosamines	SV								5,850 (1)				
Nitrosodibutylamine	SV		10	b							0.0064	0.587	
Nitrosodiethylamine	SV		10	b							0.0008	1.24	
Nitrosodimethylamine	SV		10	b							0.0014	16	
Nitrosopyrrolidine	SV		10	b							0.016	91.9	

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	Fish Consumption Only	NRC Effluent Standards Water pCi/L
N-Nitrosodiphenylamine	SV	10	10	b							4.9 **	16.1 **	
N-Nitroso-di-n-dipropylamine	SV	10	10	b									
Pentachlorinated Ethanes	SV			b					7,240 (1)	1,100 (1)			
Pentachlorobenzene	SV		10	b							74	85	
Pentachlorophenol	SV	50	50	CS		1 (f)		0 (f)	20 (4)	13 (4)	1,010		
Phenanthrene	SV	10	10	CS									
Phenol	SV	10	50	CS					10,200 (1)	2,560 (1)	3,500		
Phthalate Esters	SV			e					940 (1)	3 (1)			
Polynuclear Aromatic Hydrocarbons	SV		10	b							0.0028**	0.0311**	
Vinyl Chloride	SV	10	2	CV	2		0				2 **	525 **	
1,1,1-Trichloroethane	V	5	1	CV	200		200				18,400	1,030,000	
1,1 2,2-Tetrachloroethane	V	5	1	CV						2,400	0.17**	10.7 **	
1,1,2-Trichloroethane	V	5	1	CV						9,400	0.6**	41.8 **	
1,1-Dichloroethane	V	5		CV									
1,1-Dichloroethene	V	5	1	CV	7		7						
1,2-Dichloroethane	V	5	1	CV	5		0		118,000	20,000	0.94**	243 **	
1,2-Dichloroethene (cis)	V		1	a		70		70					
1,2-Dichloroethene (total)	V	5		CV									
1,2-Dichloroethene (trans)	V	5	1	a		100		100					
1,2-Dichloropropane	V	5	1	CV		5		0	23,000	5,700			
1,3-Dichloropropene (cis)	V	5	1	CV					6,060	244 (1)	87	14,100	
1,3-Dichloropropene (trans)	V	5	1	CV					6,060	244 (1)	87	14,100	
2-Butanone	V	10		CV									
2-Hexanone	V	10		CV									
4-Methyl-2-pentanone	V	10		CV									
Acetone	V	10		CV									
Acrylonitrile	V		5	c					7,500	2,600	0.058	0.65	
Benzene	V	5	1	CV	5		0		5,300		0.66**	40 **	

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL MDL RFP	CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	Fish Consumption Only	NRC Effluent Standards Water pCi/L
Bromodichloromethane	V	5	1	CV									
Bromoform	V	5	1	CV									
Bromomethane	V	10	1	CV									
Carbon Disulfide	V	5		CV									
Carbon Tetrachloride	V	5	1	CV	5		0		35,200 (1)		0.4**	6.94 **	
Chlorinated Benzenes	V	10		CV/CS					250 (1)	50 (1)			
Chlorobenzene	V	5	1	CV/CS		100		100					
Chloroethane	V	10		CV									
Chloroform	V	5	1	CV	Tot THM<100 (2)				28,900 (1)	1,240 (1)	0.19 **	15.7 **	
Chloromethane	V	10	1	CV									
Dibromochloromethane	V	5	1	CV									
Dichloroethenes	V		1						11,600 (1)		0.033**	1.85 **	
Ethyl Benzene	V	5	1	CV		700		700	32,000 (1)		1,400	3,280	
Ethylene Dibromide	V			d		0.05		0					
Ethylene Oxide	V												
Halomethanes	V				100				11,000 (1)		0.19**	15.7 **	
Methylene Chloride	V	5	1	CV									
Pyrene	V	10	10	CS									
Styrene	V	5		CV		100		100					
Tetrachloroethanes	V	5	1	CV					9,320 (1)				
Tetrachloroethene	V	5	1	CV		5		0	5,280 (1)	840 (1)	0.80**	8.85 **	
Toluene	V	5	1	CV		1,000		1,000	17,500 (1)		14,300	424,000	
Trichloroethanes	V	5	1	CV					18,000 (1)				
Trichloroethene	V	5	1	CV	5		0		45,000 (1)	21,900 (1)	2.7 **	80.7 **	
Vinyl Acetate	V	10		CV									
Xylenes (total)	V	5		CV		10,000		10,000					

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

					SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)		NRC Effluent Standards
		PQL											
		MDL							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only	Water pCi/L
Parameter	Type (7)	RFP	CDH	Method (8)									

EXPLANATION OF TABLE

* = *secondary maximum contaminant level*

** = *Human health criteria for carcinogens reported for three risk levels.* Value presented is the 10-5 risk level.

AWQC = Ambient Water Quality Criteria
CLP = Contract Laboratory Program
CWA = Clean Water Act
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
PQL = Practical Quantitation Level
SDWA = Safe Drinking Water Act
SS = Species Specific
TAL = Target Analyte List
THM = Total Trihalomethanes
TIC = Tentatively Identified Compound
MDL = Minimum Detection Limit for radionuclides (pCi/l)
ug/l = micrograms per liter
VOA = Volatile Organic Analysis

(1) *criteria not developed;* value presented is lowest observed effects level (LOEL)
(2) total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
(3) hardness dependent criteria
(4) pH dependent criteria (7.8 pH used)
(5) standard is not adequately protective when chloride is associated with potassium, calcium, or magnesium, rather than sodium.
(6) if both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr.
(7) type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; I=indicator; FP=field parameter; M=metal; P=pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile

TABLE 3-2. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (7)	PQL / MDL / RFP	CDH	Method (8)	SDWA Maximum Contaminant Levels (a)	SDWA Maximum Contaminant Levels (b)	SDWA Maximum Contaminant Level Goals (a)	SDWA Maximum Contaminant Level Goals (b)	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only	NRC Effluent Standards Water pCi/L

(8) method abbreviations are: CT=CLP-TAL; NC=non-CLP; CV=CLP-VOA; CS=CLP-SEMI; EP=EPA-PEST; CP=CLP-PEST; E=EPA; a = detected as total in CV; b = detected as TIC in CS;
c = detected as TIC in CV; d = not routinely monitored; e = monitored in discharge ponds; f = mixture-individual isomers detected.

(9) MDL for radium 226 is 0.5; MDL for radium 228 is 1.0

(10) Value for gross alpha excludes uranium

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of May 1990).

(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142 and 143, Final Rule, effective July 30, 1992 (56 Federal Register 3526; 1/30/1991).

(c) EPA, Quality Criteria for Protection of Aquatic Life, 1986

(d) EPA, National Ambient Water Quality Criteria for Selenium - 1987

(e) EPA, National Ambient Water Quality Criteria for Chloride - 1988

(f) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, and 143, Final Rule (56 FR 30266; 7/1/1991) effective 1/1/1993.

(g) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/1991) effective 12/7/91.

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Bicarbonate	A	10,000		E310.1										
Carbonate	A	10,000		E310.1										
Chloride	A	5,000		E325								250,000		
Chlorine	A	1,000		E4500					19	11				
Fluoride	A	5,000		E340								2,000		
N as Nitrate	A	5,000		E353.1							100,000	10,000		
N as Nitrate+Nitrite	A	5,000		E353.1							100,000	10,000		
N as Nitrite	A	5,000		E354.1					SS	SS	10,000	1,000		
Sulfate	A	5,000		E375.4								250,000		
Sulfide	A									2		50		
Coliform (Fecal)	B	1		SM9221C								2000/100 ml		
Ammonia as N	C	5,000		E350					620	60		500		
Dioxin	D			d	0.00000022	0.000000013	0.01	0.00001						
Sulfur	E	100,000		E600										
Dissolved Oxygen	FP	500		SM4500					5,000	5,000	3,000	3,000		
pH	FP	0.1		E150.1					6.5-9.0	6.5-9.0		5.0-9.0		
Specific Conductance	FP	1		E120.1										
Temperature	FP								30 degrees	30 degrees				
Boron	I	5,000		E6010							750			
Total Dissolved Solids	I	10,000		E160.1										
Aluminum	M	200		CT					750	87				
Antimony	M	60		CT								14		
Arsenic	M	10		CT					360	150	100	50		
Arsenic III	M													
Arsenic V	M													
Barium	M	200		CT								1,000		
Beryllium	M	5		CT							100	0.0076		

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water Supply	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water and Fish	Statewide Standards (a): Aquatic Life (8) Acute Value	Statewide Standards (a): Aquatic Life (8) Chronic Value	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Acute Value (2)	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Chronic Value (2)	Statewide Standards (a): Tables I,II,III (1) Agricul-tural Standard (3)	Statewide Standards (a): Tables I,II,III (1) Domestic Water Supply (4)	Basin Standards (b): Organics (7) Aquatic Life	Basin Standards (b): Organics (7) Water Supply
Cadmium	M	5		CT					TVS	TVS	10	10		
Calcium	M	5,000		CT										
Cesium	M	1,000		NC										
Chromium	M	10		CT										
Chromium III	M	5		SW8467196					TVS	TVS	100	50		
Chromium VI	M	10		E218.5					16	11	100	50		
Cobalt	M	50		CT										
Copper	M	25		CT					TVS	TVS	200	1,000		
Cyanide	M	10		CT					5	5	200	200		
Iron	M	100		CT						1,000		300 (dis)		
Lead	M	5		CT					TVS	TVS	100	50		
Lithium	M	100		NC										
Magnesium	M	5000		CT										
Manganese	M	15		CT						1,000	200	50 (dis)		
Mercury	M	0.2		CT					2.4	0.1		2.0		
Molybdenum	M	200		NC										
Nickel	M	40		CT					TVS	TVS	200			
Potassium	M	5000		CT										
Selenium	M	5		CT					135	17	20	10		
Silver	M	10		CT					TVS	TVS		50		
Sodium	M	5000		CT										
Strontium	M	200		NC										
Thallium	M	10		CT						15		0.012		
Tin	M	200		NC										
Titanium	M	10		E6010										
Tungsten	M	10		E6010										
Vanadium	M	50		CT										
Zinc	M	20		CT					TVS	TVS	2,000	5,000		
2,4,5-TP Silvex	P		0.5	d	50									

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
2,4-D	P		1	d	70									100
Acrolein			10			320	68	21						
Aldicarb	P		10		10									
Aldrin	P	0.05	0.1	CP	0.002 (8)	0.00013	1.5						0.003	
Bromacil	P													
Carbofuran	P			d	36									
Chloranil	P			E619										
Chlordane (Alpha)	P	0.5	1	CP	0.03 (8)		1.2	0.0043						
Chlordane (Gamma)	P	0.5	1	CP	0.03 (8)	0.00058	1.2	0.0043						
Chlorpyrifos	P		0.1				0.083	0.041						
DDT	P	0.1	0.1	CP	0.1	0.00059	0.55	0.001					0.001	
DDT Metabolite (DDD)	P	0.1	0.1	CP		0.0008	0.6						0.001	
DDT Metabolite (DDE)	P	0.1	0.1	CP	0.1	0.00059	1,050						0.001	
Demeton	P		1					0.1					0.1	
Diazinon	P													
Dieldrin	P	0.1	0.1	CP	0.002	0.00014	1.3	0.0019					0.003	
Endosulfan I	P	0.05	0.1	CP		0.93	0.11	0.056					0.003	
Endosulfan II	P	0.1	0.1	CP										
Endosulfan Sulfate	P	0.1	0.1	CP		0.93								
Endrin	P	0.1	0.1	CP	0.2		0.09	0.0023					0.004	
Endrin Aldehyde	P		0.1		0.2	0.2								
Endrin Ketone	P	0.1		CP										
Guthion	P		1.5					0.01					0.01	
Heptachlor	P	0.05	0.05	CP	0.008	0.00021	0.26	0.0038					0.001	0.2
Heptachlor Epoxide	P	0.05	0.05	CP	0.09	0.0001	0.26	0.0038						
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP	0.006		0.0039							
Hexachlorocyclohexane, Beta	P	0.05	0.05	CP		0.014								
Hexachlorocyclohexane, BHC	P	0.05	0.05				100							
Hexachlorocyclohexane, Delta	P	0.05		CP										
Hexachlorocyclohexane, Tech.	P		0.2	f		0.012								

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
		PQL MDL							Aquatic Life					
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Hexachlorocyclohexane, Lindane	P	0.05	0.05	CP	0.2	0.019	1.0	0.08					0.01	4.0
Malathion	P		0.2					0.1					0.1	
Methoxychlor	P	0.5	0.5	CP	40			0.03					0.03	100
Mirex	P		0.1					0.001					0.001	
Parathion	P												0.04	
PCBs	P	0.5	1	CP	0.005	0.000044	2.0	0.014					0.001	
Simazine	P			e										
Toxaphene	P	1	5	CP	0.03	0.00073	0.73	0.0002					0.005	5.0
Vaponite 2	P													
Aroclor 1016	PP	0.5		CP										
Aroclor 1221	PP	0.5		CP										
Aroclor 1232	PP	0.5		CP										
Aroclor 1242	PP	0.5		CP										
Aroclor 1248	PP	0.5		CP										
Aroclor 1254	PP	1		CP										
Aroclor 1260	PP	1		CP										
Atrazine	PP			e										
Americium (pCi/l)	R													
Americium 241 (pCi/l)	R	0.01												
Cesium 134 (pCi/l)	R	1			80 (10)									
Cesium 137 (pCi/l)	R	1												
Gross Alpha (pCi/l)	R	2												
Gross Beta (pCi/l)	R	4												
Plutonium (pCi/l)	R													
Plutonium 238+239+240 (pCi/l)	R	0.01			15 (10)									
Radium 226+228 (pCi/l)	R	0.5/1 (9)			5 (10)									
Strontium 89+90 (pCi/l)	R	1												
Strontium 90 (pCi/l)	R				8 (10)									
Thorium 230+232 (pCi/l)	R				60 (10)									

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Statewide Standards (a): Human Health Carcinogens/Noncarcinogens (2) (8) Water Supply	Statewide Standards (a): Human Health Carcinogens/Noncarcinogens (2) (8) Water and Fish	Statewide Standards (a): Aquatic Life (8) Acute Value	Statewide Standards (a): Aquatic Life (8) Chronic Value	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Acute Value (2)	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Chronic Value (2)	Statewide Standards (a): Tables I,II,III (1) Agricultural Standard (3)	Statewide Standards (a): Tables I,II,III (1) Domestic Water Supply (4)	Basin Standards (b): Organics (7) Aquatic Life	Basin Standards (b): Organics (7) Water Supply
Tritium (pCi/l)	R				20,000 (10)									
Uranium 233+234 (pCi/l)	R													
Uranium 235 (pCi/l)	R	0.6												
Uranium 238 (pCi/l)	R	0.6												
Uranium (Total) (pCi/l)	R								TVS	TVS				
1,2,4,5-Tetrachlorobenzene	SV		10	b	2 (8)									
1,2,4-Trichlorobenzene	SV	10		CS										
1,2-Dichlorobenzene (Ortho)	SV	10	1	CS	620	620								
1,2-Diphenylhydrazine	SV			b	0.05	0.04	270							
1,3-Dichlorobenzene (Meta)	SV	10	1	CS	620	400								
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75	75								
2,4,5-Trichlorophenol	SV	50		CS										
2,4,6-Trichlorophenol	SV	10	50	CS	2	2		970						
2,4-Dichlorophenol	SV	10	50	CS	21	21	2,020	365						
2,4-Dimethylphenol	SV	10	50	CS			2,120							
2,4-Dinitrophenol	SV	50	50	CS	14	14								
2,4-Dinitrotoluene	SV	10	10	CS		0.11								
2,6-Dinitrotoluene	SV	10	10	CS			330	230						
2-Chloronaphthalene	SV	10		CS										
2-Chlorophenol	SV	10	50	CS			4,380	2,000						
2-Methylnaphthalene	SV	10		CS										
2-Methylphenol	SV	10		CS										
2-Nitroaniline	SV	50		CS										
2-Nitrophenol	SV	10		CS										
3,3-Dichlorobenzidine	SV	20	10	CS		0.039								
3-Nitroaniline	SV	50		CS										
4,6-Dinitro-2-methylphenol	SV	50	50	CS		13								
4-Bromophenyl Phenylether	SV	10		CS										
4-Chloroaniline	SV	10		CS										

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
		PQL MDL							Aquatic Life					
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
4-Chlorophenyl Phenyl Ether	SV	10		CS										
4-Chloro-3-methylphenol	SV	10	50	CS			30							
4-Methylphenol	SV	10		CS										
4-Nitroaniline	SV	50		CS										
4-Nitrophenol	SV	50		CS										
Acenaphthene	SV	10	10	CS			1,700	520						
Anthracene	SV	10	1	CS		0.0028								
Benzidine	SV		10	d	0.0002	0.00012(8)	2,500						0.1	0.01
Benzoic Acid	SV	50		CS										
Benzo(a)anthracene	SV	10	10	CS		0.0028								
Benzo(a)pyrene	SV	10	10	CS		0.0028								
Benzo(b)fluoranthene	SV	10	10	CS		0.0028								
Benzo(g,h,i)perylene	SV	10	10	CS		0.0028								
Benzo(k)fluoranthene	SV	10	10	CS		0.0028								
Benzyl Alcohol	SV	10		CS										
bis(2-Chloroethoxy)methane	SV	10		CS										
bis(2-Chloroethyl)ether	SV	10	10	CS	0.03 (8)	0.03 (8)								
bis(2-Chloroisopropyl)ether	SV	10	10	CS		1,400								
bis(2-Ethylhexyl)phthalate	SV	10	10	CS		1.8 (8)								
Butadiene	SV													
Butyl Benzylphthalate	SV	10	10	CS		3,000								
Chlorinated Ethers	SV													
Chlorinated Napthalenes	SV													
Chloroalkylethers	SV	10		CS										
Chlorophenol	SV		50										1.0	1.0
Chrysene	SV	10	10	CS		0.0028								
Dibenzofuran	SV	10		CS										
Dibenz(a,h)anthracene	SV	10	10	CS		0.0028								
Dichlorobenzenes	SV		1											
Dichlorobenzidine	SV	20	10	CS		0.039								

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
									Aquatic Life					
	Type	PQL MDL		Method	Water	Water and	Acute	Chronic	Acute	Chronic	Agricul-tural	Domestic Water	Aquatic	Water
Parameter	(5)	RFP	CDH	(6)	Supply	Fish	Value	Value	Value (2)	Value (2)	Standard (3)	Supply (4)	Life	Supply
Diethylphthalate	SV	10	10	CS		23,000								
Dimethylphthalate	SV	10	10	CS		313,000								
Di-n-butylphthalate	SV	10	10	CS		2,700								
Di-n-octylphthalate	SV	10		CS										
Ethylene Glycol	SV			d										
Fluoranthene	SV	10	10	CS		42	3,980							
Fluorene	SV	10	10	CS		0.0028								
Formaldehyde	SV													
Haloethers	SV													
Hexachlorobenzene	SV	10	10	CS	6	0.00072								
Hexachlorobutadiene	SV	10	10	CS	1	0.45	90	9.3						
Hexachlorocyclopentadiene	SV	10	10	CS		240	7	5						
Hexachloroethane	SV	10	10	CS		1.9	980	540						
Hydrazine	SV													
Indeno(1,2,3-cd)pyrene	SV	10	10	CS		0.0028								
Isophorone	SV	10	10	CS	1,050	8.4	117,000							
Naphthalene	SV	10	10	CS		0.0028	2,300	620						
Nitrobenzene	SV	10	10	CS	3.5	3.5	27,000							
Nitrophenols	SV													
Nitrosamines	SV													
Nitrosodibutylamine	SV		10	b		0.0064								
Nitrosodiethylamine	SV		10	b		0.0008								
Nitrosodimethylamine	SV		10	b		0.00069								
Nitrosopyrrolidine	SV		10	b		0.016								
N-Nitrosodiphenylamine	SV	10	10	CSb		4.9								
N-Nitroso-di-n-dipropylamine	SV	10	10	CSb		0.005								
Pentachlorinated Ethanes	SV			b										
Pentachlorobenzene	SV		10	b	6 (8)									
Pentachlorophenol	SV	50	50	CS	200		9	5.7						
Phenanthrene	SV	10	10	CS		0.0028								

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water Supply	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8) Water and Fish	Statewide Standards (a): Aquatic Life (8) Acute Value	Statewide Standards (a): Aquatic Life (8) Chronic Value	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Acute Value (2)	Statewide Standards (a): Tables I,II,III (1) Aquatic Life Chronic Value (2)	Statewide Standards (a): Tables I,II,III (1) Agricul-tural Standard (3)	Statewide Standards (a): Tables I,II,III (1) Domestic Water Supply (4)	Basin Standards (b): Organics (7) Aquatic Life	Basin Standards (b): Organics (7) Water Supply
Phenol	SV	10	50	CS		21,000	10,200	2,560					500	1.0
Phthalate Esters	SV			e										
Polynuclear Aromatic Hydrocarbon	SV		10	b		0.0028								
Vinyl Chloride	SV	10	2	CV	2	2								
1,1,1-Trichloroethane	V	5	1	CV	200	200								
1,1,2,2-Tetrachloroethane	V	5	1	CV		0.17		2,400						
1,1,2-Trichloroethane	V	5	1	CV	3	0.6	9,400							
1,1-Dichloroethane	V	5		CV										
1,1-Dichloroethene	V	5	1	CV	7	0.057								
1,2-Dichloroethane	V	5	1	CV	0.4	0.4	118,000	20,000						
1,2-Dichloroethene (cis)	V		1	a	70									
1,2-Dichloroethene (total)	V	5		CV										
1,2-Dichloroethene (trans)	V	5	1	a	100									
1,2-Dichloropropane	V	5	1	CV	0.56 (8)	0.56	23,000	5,700						
1,3-Dichloropropene (cis)	V	5	1	CV		10	6,060	244						
1,3-Dichloropropene (trans)	V	5	1	CV		10	6,060	244						
2-Butanone	V	10		CV										
2-Hexanone	V	10		CV										
4-Methyl-2-pentanone	V	10		CV										
Acetone	V	10		CV										
Acrylonitrile	V		5	c		0.58	7,550	2,600						
Benzene	V	5	1	CV	1	1	5,300							
Bromodichloromethane	V	5	1	CV	0.3	0.3								
Bromoform	V	5	1	CV	4	4								
Bromomethane	V	10	1	CV		48								
Carbon Disulfide	V	5		CV										
Carbon Tetrachloride	V	5	1	CV	0.3	0.25	35,200							
Chlorinated Benzenes	V	10		CV/CS										
Chlorobenzene	V	5	1	CV/CVS	100	100								

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
					Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
									Aquatic Life					
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply
Chloroethane	V	10		CV										
Chloroform	V	5	1	CV	6	6	28,900	1,240						
Chloromethane	V	10	1	CV		5.7								
Dibromochloromethane	V	5	1	CV	14	6								
Dichloroethenes	V		1											
Ethyl Benzene	V	5	1	CV	680	3,100	32,000							
Ethylene Dibromide	V			d										
Ethylene Oxide	V													
Halomethanes	V				100									
Methylene Chloride	V	5	1	CV		4.7								
Pyrene	V	10	10	CS		0.0028								
Styrene	V	5		CV										
Tetrachloroethanes	V	5	1	CV										
Tetrachloroethene	V	5	1	CV	5	0.8	5,280	840						
Toluene	V	5	1	CV	1,000	1,000	17,500							
Trichloroethanes	V	5	1	CV										
Trichloroethene	V	5	1	CV	5	2.7	45,000	21,900						
Vinyl Acetate	V	10		CV										
Xylenes (Total)	V	5		CV										

EXPLANATION OF TABLE

CLP = Contract Laboratory Program
CDH = Colorado Department of Health
dis = dissolved
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
PQL = Practical Quantitation Level

TABLE 3-3. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STATEWIDE AND BASINWIDE (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Statewide Standards (a)								Basin Standards (b)	
		PQL MDL			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life				Organics (7)	
Parameter	Type (5)	RFP	CDH	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricul-tural Standard (3)	Domestic Water Supply (4)	Aquatic Life	Water Supply

SS = species specific
TAL = Target Analyte List
THM = Total Trihalomethanes
TIC = Tentatively Identified Compound
TVS = Table Value Standard (hardness dependent), see Table III in (a)
MDL = Minimum Detection Limit for radionuclides (pCi/l)
ug/l = micrograms per liter
VOA = Volatile Organic Analysis
CWQC = Colorado Water Quality Control Commission

(1) Table I = physical and biological parameters
Table II = inorganic parameters
Table III = metal parameters
Values in Tables I, II, and III for recreational uses, cold water biota and domestic water supply are not included.
(2) In the absence of specific, numeric standards for non-naturally occurring organics, the narrative standard is interpreted as zero with enforcement based on practical quantification levels (PQLs) as defined by CDH/WQCC or EPA
(3) All are 30-day standards except for nitrate+nitrite
(4) Ammonia, sulfide, chloride, sulfate, copper, iron, manganese, and zinc are 30-day standards, all others are 1-day standards
(5) type abbreviations are: A=anion; B=bacteria; C=cation; I=indicator; FP=field parameter; M=metal; P= pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(6) method abbreviations are: CT=CLP-TAL; NC=non-CLP; CV=CLP-VOA; CS=CLP-SEMI; EP=EPA-PEST; CP=CLP-PEST; E=EPA; a = detected as total in CV; b = detected as TICs in CS; c = detected as TIC in CV; d = not routinely monitored; e = monitored in discharge ponds; f = mixture-individual isomers detected.
(7) See Section 3.8.5 (2)(a) in (b)
(8) Where standard is below (more stringent than) PQL (CDH), PQL is standard.
(9) MDL for Radium 226 is 0.5; MDL for Radium 228 is 1.0
(10) See section 3.1.11 (f) (2) in (a)

(a) CDH/CWQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974; amended 10/17/1991 (ARAR). (Envrionmental Reporter 726:1001-1020:6/1990)
(b) CDH/CWQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002-8) 4/6/1981; amended 2/15/1990 - Basin-wide standards are ARAR.

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
								Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)	Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Acute Value	Chronic Value	Woman Creek	Walnut Creek
Bicarbonate	A	10,000		E310.1							
Carbonate	A	10,000		E310.1							
Chloride	A	5,000		E325				250,000	250,000		
Chlorine	A	1,000		E4500				3	3		
Fluoride	A	5,000		E340							
N as Nitrate	A	5,000		E353.1				10,000	10,000		
N as Nitrate+Nitrite	A	5,000		E353.1							
N as Nitrite	A	5,000		E354.1				1,000	1,000		
Sulfate	A	5,000		E375.4				250,000	250,000		
Sulfide	A										
Coliform (Fecal)	B	1		SM9221C							
Ammonia as N	C	5,000		E350				620	60		
Dioxin	D			d	0.00000022	0.000000013			0.000000013		
Sulfur	E	100,000		E600				2.0	2.0		
Dissolved Oxygen	FP	500		SM4500				5,000	5,000		
pH	FP	0.1		E150.1				6.5-9	6.5-9		
Specific Conductance	FP	1		E120.1							
Temperature	FP										
Boron	I	5,000		E6010				750	750		
Total Dissolved Solids	I	10,000		E160.1							
Aluminum	M	200		CT							
Antimony	M	60		CT							
Arsenic	M	10		CT				50			
Arsenic III	M										
Arsenic V	M										
Barium	M	200		CT							
Beryllium	M	5		CT							

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL						Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)	Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Acute Value	Chronic Value	Woman Creek	Walnut Creek
Cadmium	M	5		CT				TVS	TVS		
Calcium	M	5,000		CT							
Cesium	M	1,000		NC							
Chromium	M	10		CT							
Chromium III	M	5		SW8467196				50			
Chromium VI	M	10		E218.5				TVS	TVS		
Cobalt	M	50		CT							
Copper	M	25		CT				TVS	TVS		
Cyanide	M	10		CT				5	5		
Iron	M	100		CT					300 (3)		
Lead	M	5		CT				TVS	TVS		
Lithium	M	100		NC							
Magnesium	M	5000		CT							
Manganese	M	15		CT					50 (3)		
Mercury	M	0.2		CT					0.01		
Molybdenum	M	200		NC							
Nickel	M	40		CT				TVS	TVS		
Potassium	M	5000		CT							
Selenium	M	5		CT				10			
Silver	M	10		CT				TVS	TVS		
Sodium	M	5000		CT							
Strontium	M	200		NC							
Thallium	M	10		CT							
Tin	M	200		NC							
Titanium	M	10		E6010							
Tungsten	M	10		E6010							
Vanadium	M	50		CT							
Zinc	M	20		CT				TVS	TVS		
2,4,5-TP Silvex	P		0.5	d	10						

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
					Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
2,4-D	P		1	d	100						
Acrolein	P		10								
Aldicarb	P		10		10						
Aldrin	P	0.05	0.1	CP	0.002 (6)	0.000074			0.000074		
Bromacil	P										
Carbofuran	P			d	36						
Chloranil	P			E619							
Chlordane (Alpha)	P	0.5	1	CP	0.03 (6)	0.00046			0.00046		
Chlordane (Gamma)	P	0.5	1	CP	0.03 (6)	0.00046			0.00046		
Chlorpyrifos	P		0.1								
DDT	P	0.1	0.1	CP	0.1 (6)	0.000024			0.000024		
DDT Metabolite (DDD)	P	0.1	0.1	CP							
DDT Metabolite (DDE)	P	0.1	0.1	CP							
Demeton	P		1								
Diazinon	P										
Dieldrin	P	0.1	0.1	CP	0.002 (6)	0.000071			0.000071		
Endosulfan I	P	0.05	0.1	CP							
Endosulfan II	P	0.1	0.1	CP							
Endosulfan Sulfate	P	0.1	0.1	CP							
Endrin	P	0.1	0.1	CP	0.2						
Endrin Aldehyde	P		0.1								
Endrin Ketone	P	0.1		CP							
Guthion	P		1.5								
Heptachlor	P	0.05	0.05	CP	0.008 (6)	0.00028			0.00028		
Heptachlor Epoxide	P	0.05	0.05	CP	0.004 (6)						
Hexachlorocyclohexane, Alpha	P	0.05	0.05	CP		0.0092			0.0092		
Hexachlorocyclohexane, Beta	P	0.05	0.05	CP		0.0163			0.0163		
Hexachlorocyclohexane, BHC	P	0.05	0.05								
Hexachlorocyclohexane, Delta	P	0.05		CP							
Hexachlorocyclohexane, Tech.	P		0.2	f		0.0123			0.0123		

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
					Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Hexachlorocyclohexane, Lindane	P	0.05	0.05	CP	4	0.0186			0.0186		
Malathion	P		0.2								
Methoxychlor	P	0.5	0.5	CP	100						
Mirex	P		0.1								
Parathion	P										
PCBs	P	0.5	1	CP	0.005 (6)	0.000079			0.000079		
Simazine	P			e		4			4		
Toxaphene	P	1	5	CP	5						
Vaponite 2	P										
Aroclor 1016	PP	0.5		CP							
Aroclor 1221	PP	0.5		CP							
Aroclor 1232	PP	0.5		CP							
Aroclor 1242	PP	0.5		CP							
Aroclor 1248	PP	0.5		CP							
Aroclor 1254	PP	1		CP							
Aroclor 1260	PP	1		CP							
Atrazine	PP			e		3			3		
Americium (pCi/l)	R									0.05	0.05
Americium 241 (pCi/l)	R	0.01					30				
Cesium 134 (pCi/l)	R	1			80		80			80	80
Cesium 137 (pCi/l)	R	1									
Gross Alpha (pCi/l)	R	2								7	11
Gross Beta (pCi/l)	R	4								5	19
Plutonium (pCi/l)	R									0.05	0.05
Plutonium 238+239+240 (pCi/l)	R	0.01					15				
Radium 226+228 (pCi/l)	R	0.5/1.0 (7)					5				
Strontium 89+90 (pCi/l)	R	1									
Strontium 90 (pCi/l)	R						8			8	8
Thorium 230+232 (pCi/l)	R						60				

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

Parameter	Type (5)	PQL MDL RFP	PQL MDL CDH	Method (6)	Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4): Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5): Acute Value	Stream Segment Table (5): Chronic Value	Table 2 Radionuclides: Woman Creek	Table 2 Radionuclides: Walnut Creek
Tritium (pCi/l)	R						20,000			500	500
Uranium 233+234 (pCi/l)	R										
Uranium 235 (pCi/l)	R	0.6									
Uranium 238 (pCi/l)	R	0.6									
Uranium (Total) (pCi/l)	R						40			5	10
1,2,4,5-Tetrachlorobenzene	SV		10	b	2 (6)						
1,2,4-Trichlorobenzene	SV	10		CS							
1,2-Dichlorobenzene (Ortho)	SV	10	1	CS	620						
1,2-Diphenylhydrazine	SV			b	0.05 (6)						
1,3-Dichlorobenzene (Meta)	SV	10	1	CS	620						
1,4-Dichlorobenzene (Para)	SV	10	1	CS	75						
2,4,5-Trichlorophenol	SV	50		CS	700						
2,4,6-Trichlorophenol	SV	10	50	CS	2.0 (6)	1.2			1.2		
2,4-Dichlorophenol	SV	10	50	CS	21 (6)						
2,4-Dimethylphenol	SV	10	50	CS							
2,4-Dinitrophenol	SV	50	50	CS							
2,4-Dinitrotoluene	SV	10	10	CS							
2,6-Dinitrotoluene	SV	10	10	CS							
2-Chloronaphthalene	SV	10		CS							
2-Chlorophenol	SV	10	50	CS							
2-Methylnaphthalene	SV	10		CS							
2-Methylphenol	SV	10		CS							
2-Nitroaniline	SV	50		CS							
2-Nitrophenol	SV	10		CS							
3,3-Dichlorobenzidine	SV	20	10	CS		0.01			0.01		
3-Nitroaniline	SV	50		CS							
4,6-Dinitro-2-methylphenol	SV	50	50	CS							
4-Bromophenyl Phenylether	SV	10		CS							
4-Chloroaniline	SV	10		CS							

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
4-Chlorophenyl Phenyl Ether	SV	10		CS							
4-Chloro-3-methylphenol	SV	10	50	CS							
4-Methylphenol	SV	10		CS							
4-Nitroaniline	SV	50		CS							
4-Nitrophenol	SV	50		CS							
Acenaphthene	SV	10	10	CS							
Anthracene	SV	10	1	CS							
Benzidine	SV		10	d	0.0002 (6)	0.00012			0.00012		
Benzoic Acid	SV	50		CS							
Benzo(a)anthracene	SV	10	10	CS							
Benzo(a)pyrene	SV	10	10	CS							
Benzo(b)fluoranthene	SV	10	10	CS							
Benzo(g,h,i)perylene	SV	10	10	CS							
Benzo(k)fluoranthene	SV	10	10	CS							
Benzyl Alcohol	SV	10		CS							
bis(2-Chloroethoxy)methane	SV	10		CS							
bis(2-Chloroethyl)ether	SV	10	10	CS	0.03 (6)	0.0000037			0.0000037		
bis(2-Chloroisopropyl)ether	SV	10	10	CS							
bis(2-Ethylhexyl)phthalate	SV	10	10	CS							
Butadiene	SV										
Butyl Benzylphthalate	SV	10		CS							
Chlorinated Ethers	SV										
Chlorinated Napthalenes	SV										
Chloroalkylethers	SV	10		CS							
Chlorophenol	SV		50								
Chrysene	SV	10	10	CS							
Dibenzofuran	SV	10		CS							
Dibenz(a,h)anthracene	SV	10	10	CS							
Dichlorobenzenes	SV		1								
Dichlorobenzidine	SV	20	10	CS		0.01			0.01		

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL			Tables	Table C	Table D	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)	A,B (1)	Fish & Water Ingestion	Radio-nuclide	Acute Value	Chronic Value	Woman Creek	Walnut Creek
Diethylphthalate	SV	10	10	CS							
Dimethylphthalate	SV	10	10	CS							
Di-n-butylphthalate	SV	10	10	CS							
Di-n-octylphthalate	SV	10		CS							
Ethylene Glycol	SV			d							
Fluoranthene	SV	10	10	CS							
Fluorene	SV	10	10	CS							
Formaldehyde	SV										
Haloethers	SV										
Hexachlorobenzene	SV	10	10	CS	0.02 (6)	0.00072			0.00072		
Hexachlorobutadiene	SV	10	10	CS	14	0.45			0.45		
Hexachlorocyclopentadiene	SV	10	10	CS	49						
Hexachloroethane	SV	10	10	CS		1.9			1.9		
Hydrazine	SV										
Indeno(1,2,3-cd)pyrene	SV	10	10	CS							
Isophorone	SV	10	10	CS	1,050						
Naphthalene	SV	10	10	CS							
Nitrobenzene	SV	10	10	CS	3.5 (6)						
Nitrophenols	SV										
Nitrosamines	SV										
Nitrosodibutylamine	SV		10	b		0.0064			0.0064		
Nitrosodiethylamine	SV		10	b		0.0008			0.0008		
Nitrosodimethylamine	SV		10	b		0.0014			0.0014		
Nitrosopyrrolidine	SV		10	b		0.016			0.016		
N-Nitrosodiphenylamine	SV	10	10	CSb		4.9			4.9		
N-Nitroso-di-n-dipropylamine	SV	10	10	CSb							
Pentachlorinated Ethanes	SV			b							
Pentachlorobenzene	SV		10	b	6 (6)						
Pentachlorophenol	SV	50	50	CS	200						
Phenanthrene	SV	10	10	CS							

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL						Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	RFP	CDH	Method (6)	Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Acute Value	Chronic Value	Woman Creek	Walnut Creek
Phenol	SV	10	50	CS							
Phthalate Esters	SV			e							
Polynuclear Aromatic Hydrocarbons	SV		10	b		0.0028			0.0028		
Vinyl Chloride	SV	10	2	CV	2						
1,1,1-Trichloroethane	V	5	1	CV	200						
1,1,2,2-Tetrachloroethane	V	5	1	CV		0.17			0.17		
1,1,2-Trichloroethane	V	5	1	CV	28	0.60			0.60		
1,1-Dichloroethane	V	5		CV							
1,1-Dichloroethene	V	5	1	CV	7						
1,2-Dichloroethane	V	5	1	CV	5						
1,2-Dichloroethene (cis)	V		1	a	70						
1,2-Dichloroethene (total)	V	5		CV							
1,2-Dichloroethene (trans)	V	5	1	a	70						
1,2-Dichloropropane	V	5	1	CV	0.56 (6)						
1,3-Dichloropropene (cis)	V	5	1	CV							
1,3-Dichloropropene (trans)	V	5	1	CV							
2-Butanone	V	10		CV							
2-Hexanone	V	10		CV							
4-Methyl-2-pentanone	V	10		CV							
Acetone	V	10		CV							
Acrylonitrile	V		5	c		0.058			0.058		
Benzene	V	5	1	CV	5						
Bromodichloromethane	V	5	1	CV							
Bromoform	V	5	1	CV							
Bromomethane	V	10	1	CV							
Carbon Disulfide	V	5		CV							
Carbon Tetrachloride	V	1		CV	5						
Chlorinated Benzenes	V	10		CV/CS							
Chlorobenzene	V	5	1	CV/CVS	300						

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992) STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
					Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5)		Table 2 Radionuclides	
Parameter	Type (5)	PQL MDL RFP	CDH	Method (6)				Acute Value	Chronic Value	Woman Creek	Walnut Creek
Chloroethane	V	10		CV							
Chloroform	V	5	1	CV	Tot THM <100*	0.19			0.19		
Chloromethane	V	10	1	CV							
Dibromochloromethane	V	5	1	CV							
Dichloroethenes	V		1								
Ethyl Benzene	V	5	1	CV	680						
Ethylene Dibromide	V			d							
Ethylene Oxide	V										
Halomethanes	V				100	0.19			0.19		
Methylene Chloride	V	5	1	CV							
Pyrene	V	10	10	CS							
Styrene	V	5		CV							
Tetrachloroethanes	V	5	1	CV		0.8			0.8		
Tetrachloroethene	V	5	1	CV	10						
Toluene	V	5	1	CV	2,420						
Trichloroethanes	V	5	1	CV							
Trichloroethene	V	5	1	CV	5						
Vinyl Acetate	V	10		CV							
Xylenes (Total)	V	5		CV							

EXPLANATION OF TABLE

* = Total trihalomethanes:chloroform, bromoform, bromodichloromethane, dibromochloromethane

CLP = Contract Laboratory Program
CDH = Colorado Department of Health
dis = dissolved
EPA = Environmental Protection Agency
pCi/l = picocuries per liter

TABLE 3-4. POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (February 1, 1992)
STREAM SEGMENT (CDH/CWQCC) SURFACE WATER QUALITY STANDARDS (ug/l)

					Segment 4 & 5 Stream Classification and Water Quality Standards (b)(4)						
		PQL MDL									
Parameter	Type (5)	RFP	CDH	Method (6)	Tables A,B (1)	Table C Fish & Water Ingestion	Table D Radio-nuclide	Stream Segment Table (5) Acute Value	Chronic Value	Table 2 Radionuclides Woman Creek	Walnut Creek

PCB = polychlorinated biphenyl
PQL = Practical Quantitation Level
RFP = Rocky Flats Plant
SS = species specific
TAL = Target Analyte List
THM = Total Trihalomethanes
TIC = Tentatively Identified Compound
TVS = Table Value Standard (hardness dependent), see Table III in (a)
MDL = Minimum Detection Limit for radionuclides (pCi/l)
ug/l = micrograms per liter
VOA = Volatile Organic Analysis
CWQCC = Colorado Water Quality Control Commission

(1) In the absence of specific, numeric standards for non-naturally occurring organics, the narrative standard is interpreted as zero with enforcement based on practical quantification levels (PQLs) as defined by CDH/CWQCC or EPA
(2) Ammonia, sulfide, chloride, sulfate, copper, iron, manganese, and zinc are 30-day standards, all others are 1-day standards
(3) Lowest value given: dissolved or total recoverable
(4) Segment 5 standards are goals
(5) Includes Table 1: Additional Organic Chemical Standards (chronic only)
(6) Standard is below (more stringent than) PQL, therefore PQL is standard.
(7) MDL for Radium 226 is 0.5; MDL for Radium 228 is 1.0

(a) CDH/CWQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974; amended 9/30/1989. (Envrionmental Reporter 726:1001-1020:6/1990)
(b) CDH/CWQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002-8) 4/6/1981; amended 2/15/1990.

Approved by:

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Manager, Remediation Programs RFI Project Manager

4.0 DATA NEEDS AND DATA QUALITY OBJECTIVES

The primary objective of an RFI/RI is collection of data necessary to determine the nature, distribution, and migration pathways of contaminants and to quantify any risks to human health and the environment. These assessments determine the need for remediation and are used to evaluate remedial alternatives, if necessary. The five general goals of an RFI/RI (U.S. EPA, 1988a) are as follows:

1. Characterize site physical features
2. Define contaminant sources
3. Determine the nature and extent of contamination
4. Describe contaminant fate and transport
5. Provide a baseline risk assessment

DQOs are qualitative and quantitative statements that specify the quality and quantity of data required to support the objectives of the RFI/RI (U.S. EPA, 1987a). The DQO process is divided into three stages:

Stage 1 - Identify decision types

Stage 2 - Identify data uses/needs

Stage 3 - Design data collection program

Through application of the DQO process, site-specific goals were established for the Phase I RFI/RI and data needs were identified for achieving those goals. This section of the RFI/RI Work Plan proceeds through the DQO process specific to the Phase I RFI/RI for OU15. This section presents the rationale used in identifying OU15 data needs.

4.1 STAGE 1 - IDENTIFY DECISION TYPES

Stage 1 of the DQO process was to identify decision makers, data users, and the types of decisions that will be made as part of the Phase I RFI/RI. In accordance with the IAG, the objective of the Phase I RFI/RI is to characterize the nature and extent of potential contamination associated with OU15 IHSSs to (1) evaluate whether releases have occurred, (2) support the baseline risk assessment and closure activities, and (3) determine the need for further action.

4.1.1 Identify and Involve Data Users

Data users are divided into three groups: decision makers, primary data users, and secondary data users. The decision makers for OU15 are personnel from EG&G, DOE, EPA, and CDH who are responsible for decisions related to management, regulation, investigation, and closure of OU15 IHSSs. The decision makers are involved through the review and approval process specified in the IAG. Primary data users are individuals involved in ongoing Phase I RFI/RI activities for OU15. These individuals are the technical staff of CDH, EPA, EG&G, and EG&G subcontractors, including geoscientists, statisticians, risk assessors, engineers, and health and safety personnel. They will be involved in collection and analysis of data and in preparation of the Phase I RFI/RI report, including the Baseline Human Health Risk Assessment and the Environmental Evaluation. Secondary data users are those users who rely on RFI/RI outputs to support their activities. Secondary data users of the Phase I RFI/RI information may include personnel from EPA, CDH, EG&G, and EG&G subcontractors working in areas such as data base management, quality assurance, records control, and laboratory management.

4.1.2 Evaluate Available Data

The historical and current operational conditions of the IHSSs and associated areas within OU15 are described in Section 2.0 of this work plan. The following is a brief summary of site conditions and a discussion of the completeness and usability of existing information, based on the data presented in Section 2.0.

4.1.2.1 Physical Setting

Various sitewide investigations and RFI/RI studies for operable units adjacent to OU15 have characterized the environmental setting of the buildings in which the OU15 IHSSs are located. These studies and investigations do not provide information useful for determining whether releases have occurred from OU15 IHSSs, and if so, whether releases from OU15 IHSSs have impacted environmental media outside of the buildings.

Information is available that describes the operational histories, the design/construction of the units, inventories, secondary containment and monitoring systems, and the types of wastes stored/used at the IHSSs (Section 2.0). Routine visual inspection for leaks, spills, and releases from the IHSSs was performed historically. No documentation was found to indicate that releases had occurred from any of the IHSSs except for the Original Uranium Chip Roaster. Additionally, the presence of secondary containment and the location of the IHSSs within the buildings makes it unlikely that a release of contaminants from the IHSSs would reach and impact environmental media. However, no valid data exist to verify that releases have not occurred.

4.1.2.2 Quality and Usability of Analytical Data

Limited analytical data are available to characterize the wastes stored at some of the IHSSs. Analytical data used in characterizing potential contaminants at OU15 have not been validated in accordance with ER Program data validation guidelines specified in Section 3.0 of the RFP sitewide QAPjP (EG&G, 1991 e). It is likely that existing data would be rejected because (1) sampling/analytical protocol did not conform to significant aspects of the guidelines specified in the QAPjP (EG&G, 1991e) or (2) documentation is not sufficient to demonstrate conformance with these procedures. These data, at best, can be considered only qualitative measures of the analyte concentrations.

The analytical data have been used qualitatively to scope the Phase I RFI/RI activities and select an analytical suite for OU15 as presented in this work plan. Valid data are needed to accurately evaluate potential contamination at OU15.

4.1.3 Develop Conceptual Model

A conceptual model for the IHSSs within OU15 has been developed in Section 2.4. This model includes a description of potential sources, release mechanisms, contaminant migration pathways, receptors, and exposure routes. Because few previous studies have provided valid data, the model is a basic Phase I model. The site-specific conceptual model for OU15 is discussed briefly below.

4.1.4 Specify Phase I RFI/RI Objectives and Data Needs

Based on the existing site information (Section 2.2 and 2.3), the nature of contamination (Section 2.4), the site-specific conceptual models for OU15 (Section 2.5), and an evaluation of the quality and usability of the existing data (Section 4.1.2), site-specific Phase I RFI/RI objectives/data needs associated with identifying contaminant sources and characterizing contamination have been developed. These are summarized in Table 4-1 and are discussed below.

In accordance with the IAG, the specific objectives of the Phase I RFI/RI field investigation for OU15 are as follows:

Characterize Site Physical Features

(1) Evaluate construction and physical features of the IHSSs and secondary containment systems

(2) Further evaluate the condition of the units and containment systems

Define Contaminant Sources

(1) Identify and characterize wastes historically stored/processed at the IHSSs

(2) Further characterize wastes currently stored at the units (if present)

(3) Determine the presence or absence of contamination within the IHSSS

Determine Nature and Extent of Contamination

(1) Determine the spatial distribution of contaminants related to OU15 IHSSs

Describe Contaminant Fate and Transport

(1) Assess current condition of secondary containment systems at each IHSS

(2) Evaluate the potential migration pathways from the IHSS to environment media outside of the buildings

Provide a Baseline Risk Assessment

(1) The objectives of the Baseline Risk Assessment are discussed in Sections 8.0 and 9.0.

4.2 STAGE 2 - IDENTIFY DATA USES/NEEDS

The data needed to meet each of the site-specific Phase I RFI/RI objectives developed for OU15 are listed in Table 4-1. The associated sampling and analysis activities are also identified in Table 4-1. Specific plans for obtaining the needed data are presented in Section 7.0 (Field Sampling Plan). The following sections discuss the uses, general types, quality, and quantity of the data needed for the OU15 Phase I RFI/RI.

4.2.1 Identify Data Uses

RFI/CMS data can be categorized according to use for the following general purposes:

- Site characterization
- Health and safety
- Risk assessment
- Evaluation of alternatives
- Engineering design of alternatives
- Monitoring during remedial action
- Determination of potentially responsible parties (PRPs)

Because this work plan describes a Phase I RFI/RI, data uses such as evaluation of alternatives, engineering design, and monitoring during remediation (all remedial action activities) will not be considered. The data use for PRP determination is also not appropriate to this work plan. The remaining three data uses will be important in meeting the objectives identified in Section 4.1.4. Data uses for specific sampling and analysis activities for the Phase I investigation at OU15 are listed in Table 4-1.

4.2.2 Identify Data Types

Data types required for the OU15 Phase I RFI/RI include visual information, radiological survey data, and laboratory analytical measurement data from various types of samples (surface wipe samples, samples of wastes stored in drums, and soot samples). These data types will provide Phase I information to characterize potential contaminants at OU15 IHSSs and inside building contamination resulting from OU15 IHSSs. Selection of chemical analyses has been based on the objectives of the Phase I program and on the past activities at the units. Sample and data types are listed in Table 4-1.

4.2.3 Identify Data Quality Needs

EPA defines five levels of analytical data, listed as follows (U.S. EPA, 1987a):

- Level I - Field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative, but results are available in real time. It is the least costly of the analytical options.

- Level II - Field analysis using more sophisticated portable analytical instruments; in some cases, the instruments may be set up in a portable laboratory onsite. There is a wide range in the quality of the data that can be generated. The quality depends on the use of suitable calibration standards, reference materials, and sample preparation equipment and on the training of the operator. Results are available in real time or several hours.

- Level III - All analysis performed in an offsite laboratory. Level III analyses may or may not be performed according to CLP procedures, but the validation or documentation procedures required of CLP Level IV analysis are not usually utilized. The laboratory may or may not be a CLP laboratory.

- Level IV - CLP routine analytical services (RAS). All analyses are performed in an offsite CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.

- Level V - Analysis by non-standard methods. All analyses are performed in an offsite analytical laboratory that may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP special analytical services (SAS) are Level V.

Level II, IV, and V quality data will be necessary for performing Phase I field activities within OU15. The levels appropriate to the data need and data use have been specified in Table 4-1.

DQOs for analytical Level II data will be met by adhering to the EMD OPs for collecting field data identified in this work plan. DQOs for analytical Level IV and V data will be met by adhering to the sampling procedures identified in the work plan and the analytical requirements for hazardous substance list (HSL) analytes and radionuclides required by the GRRASP (EG&G, 1991d).

4.2.4 Identify Data Quantity Needs

Data quantity needs are based primarily on an evaluation of the information available for characterizing the nature and extent of inside building contamination at OU15. This is consistent with guidance provided in Data Quality Objectives for Remedial Response Activities (U.S. EPA, 1987a) and Guidance for Data Useability in Risk Assessments (U.S. EPA, 1990a). Additionally, data quantity needs are designed to be consistent with similar data collection activities performed for the Phase I RFI/RI for other OUs. The rationale for sampling quantities is described in the FSP presented in Section 7.0 of this work plan.

To ensure that a sufficient amount of valid data are generated, the FSP was designed to include (1) a rationale for all field activities based on an evaluation of the existing information, (2) a phased approached using screening-level techniques to identify and/or locate critical sampling sites, and (3) contingency plans for obtaining data from critical locations. These components of the FSP are discussed further in Section 7.0.

4.2.5 Evaluate Sampling/Analysis Options

Two types of activities will be performed during the Phase I field investigation: (1) screening activities and sampling activities. Screening activities (Level II) include visual inspection and radiological surveys. Analysis of wastes and surficial swipe samples will provide Level IV and V data.

Sampling options for the Phase I RFI/RI were selected on the basis of their ability to (1) obtain data consistent with the DQOs in the least intrusive manner and (2) obtain multiple types of data at each sampling location.

Analytical options were selected to obtain data meeting the DQOs and the PARCC parameters (precision, accuracy, representativeness, completeness, and comparability) discussed below.

4.2.6 Review of PARCC Parameter Information

PARCC parameters are indicators of data quality. Precision, accuracy, and completeness objectives are established for this work plan according to the analytical methods that are appropriate for the analytical levels selected.

The analytical program requirements for OU15 are discussed in Section 7.3 of this work plan. Part A of the GRRASP (EG&G, 1991d) provides a listing of the CLP analytes and detection/quantification limits for Target Compound List (TCL) volatile organics, TCL semivolatile organics, Target Analyte List (TAL) metals, pesticides/polychlorinated biphenyls (PCBs), and inorganic parameters. Part B of the GRRASP (EG&G, 1991d) provides a listing of the radionuclide analytes and their limits. These analytical methods are appropriate for meeting the data quality requirements for analytical Levels IV and V during the Phase I RFI/RI. The precision, accuracy, and completeness parameters for analytical Level I through V data are discussed below, along with the completeness and representativeness for all analytical levels.

Precision measures the reproducibility of measurements under a given set of conditions. Accuracy measures the bias or source of error in a group of measurements. Precision and accuracy objectives for the HSL constituents (analyzed according to CLP methods) are specified in Appendix B of the RFP sitewide QAPjP (EG&G, 1991e). Precision and accuracy objectives for radionuclides are specified in Part B of the GRRASP (EG&G, 1991d).

Completeness is defined as the percentage of measurements made that are judged to be valid. The target completeness objective for the OU15 field and analytical data is 100 percent, although 90 percent will be the minimum acceptable level. Again, to ensure that a sufficient amount of valid data are generated, the FSP was designed to include (1) a rationale for all field activities based on an evaluation of the existing information, (2) a phased approached using screening level techniques to identify and/or locate critical sampling sites, and (3) contingency plans for obtaining data from critical locations. These components of the FSP are discussed further in Section 7.0.

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. In order to achieve comparability, work will be performed at OU15 in accordance with approved sampling and analysis plans, standard analytical protocols, and approved OPs for data collection. Consistent units of measurement will be used for data reporting.

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a particular site or condition. Representativeness is a qualitative parameter related to the design of the sampling and analysis components of the investigative program. The FSP described in Section 7.0 of this work plan and the referenced OPs describe the rationale for the sampling program to provide for representative samples.

4.3 STAGE 3 - DESIGN DATA COLLECTION PROGRAM

The purpose of Stage 3 of the DQO process is to design the specific data collection program for the Phase I RFI/RI for OU15. To accomplish this, the elements identified in Stages 1 and 2 were assembled and the Sampling and Analysis Plan (SAP) was prepared. The SAP consists of (1) a Quality Assurance Project Plan (QAPjP) that describes the policy, organization, functional activities, and QA/QC protocols necessary to achieve the DQOs dictated by the intended use of the data and (2) an FSP that provides guidance for all fieldwork by defining in detail the sampling and data collection methods to be used in the Phase I RFI/RI for OU15. These two components are presented in Sections 7.0 and 10.0 of this work plan. A detailed discussion of all samples to be obtained is presented in Section 7.3 for each media and includes sample type, number of samples, sample location, analytical methods, and QA/QC samples.

Table 4-1: Phase I RFI/RI Data Quality Objectives

Objective	Data Need	Sampling/Analysis Activity	Analytical Level	Data Use
Characterize Site Physical Features				
1) Evaluate construction and physical features of the IHSSs and secondary containment systems	Building construction information regarding floor thickness, drain locations, etc.	• Verification of existence and location of site physical features, as necessary	Not Applicable	• Site Characterization • Baseline Risk Assessment
2) Further evaluate the physical condition of the IHSSs and secondary containment systems	Design and current condition of containment systems, surface coatings, seals, and paints	• Obtain information on and visually inspect the sites, floors, walls, equipment, and secondary containment systems	Not Applicable	• Site Characterization • Baseline Risk Assessment
Define Contaminant Sources				
1) Identify and characterize wastes historically stored/processed at the IHSSs	Information from the Waste Stream and Residue Identification and Characterization program and waste manifests/records.	• Obtain information on fate and transport characteristics	Not Applicable	• Site Characterization • Baseline Risk Assessment
2) Further characterize wastes currently stored at the IHSSs (if present)	Forms of wastes (solid, liquid, mixed) and chemical composition of wastes	• Collect samples of drum contents; analyze samples for TAL metals, TCL volatiles, and radionuclides. Collect samples of bottle contents at IHSS 217; analyze samples for cyanide.	IV (V for radiological analytes)	• Site Characterization • Baseline Risk Assessment
3) Determine presence or absence of contamination within the IHSSs	Analyte concentrations inside IHSS boundaries	• Conduct radiological (HPGD) survey • Collect surficial swipe samples; analyze samples for TAL metals, TCL volatiles, and radionuclides	II IV (V for radiological analyses)	• Site Characterization • Baseline Risk Assessment • Environmental Evaluation

Objective	Data Need	Sampling/Analysis Activity	Analytical Level	Data Use
<u>Determine Nature and Extent of Contamination</u>				
1) Determine the spatial distribution of contaminants related to the IHSSs	Distribution of analyte concentrations inside and outside of the IHSS boundaries	• Conduct surface radiological (HPGD) survey; Collect swipe samples; analyze samples for TAL metals, TCL volatiles, and radionuclides	II IV (V for radiological analyses)	• Site Characterization • Baseline Risk Assessment
<u>Describe Contaminant Fate and Transport</u>				
1) Assess current condition of secondary containment systems at each IHSS	Location and extent of damage, if any	• Conduct site inspection and formally document conditions	Not Applicable	• Site Characterization • Baseline Risk Assessment
2) Evaluate potential contamination migration pathways from each IHSSs to the environment outside of the buildings	Information on the thickness of concrete underlying the IHSSs, cracks, etc.	• Conduct site inspection and formally document conditions	Not Applicable	• Site Characterization • Baseline Risk Assessmen
<u>Support a Baseline Risk Assessment</u>				
1) Sections 8.0 and 9.0 of this work plan				

Approved by:

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Manager, Remediation Programs RFI Project Manager

5.0 RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION TASKS

5.1 TASK 1 - PROJECT PLANNING

The project planning task includes all efforts required to initiate the Phase I RFI/RI for OU15. Activities undertaken for this project have included review of previous investigation results relevant to OU15, preliminary site characterization, and scoping of the Phase I RFI/RI. Results of these activities are presented in Sections 2.0, 3.0, and 4.0.

Prior to performing field investigations for OU15, it will be necessary to review new information and data that become available after preparation of this work plan. New information to be evaluated prior to initiation of field activities for OU15 may include data from sitewide surface water and ground water monitoring programs and recent information from the WSIC program.

Two project planning documents, including this work plan, have been prepared for the OU15 Phase I RFI/RI as required by the IAG. An FSP included in this document presents the locations, media, and frequency of sampling efforts. The second document required by the IAG is an SAP, which includes a QAPjP and OPs for all field activities. The QAPjP and OPs are being revised in accordance with the IAG.

5.2 TASK 2 - COMMUNITY RELATIONS

In accordance with the IAG, the RFP is developing a Community Relations Plan (CRP) to inform and actively involve the public in decision-making as it relates to environmental restoration activities. The CRP will address the needs and concerns of the surrounding communities as identified through approximately 80 interviews with federal, state, and local elected officials; businesses; medical professionals; educational representatives; interest groups; media; and residents adjacent to the RFP.

A Draft CRP was issued for public comment in January 1991. The Draft CRP was revised to reflect public comment, and following EPA and CDH approval, a final CRP was released in August 1991. Accordingly, a site-specific CRP is not required for OU15.

Current community relations activities concerning environmental restoration include participation by plant representatives in informational workshops; presentations at meetings of the Rocky Flats Environmental Monitoring Council; briefings for citizens, businesses, and surrounding communities on environmental restoration and monitoring activities; and public comment opportunities on various EM Program plans and actions. RFP personnel involve several special interest groups in decisions that pertain to environmental restoration activities, including the Rocky Flats Cleanup Commission, the recipient of the EPA Technical Assistant Grant.

In addition, a Speakers' Bureau program provides plant speakers to civic groups and educational organizations, and a public tours program allows the public to visit the RFP. RFP also produces fact sheets and periodic updates on environmental restoration activities for public information and responds to numerous public inquiries regarding the RFP.

5.3 TASK 3 - FIELD INVESTIGATION

The Phase I RFI/RI field investigation is designed to meet the objectives outlined in Section 4.0 of this work plan. Additionally, the data will be used to support the Phase I Baseline Risk Assessment.

Four types of activities will be performed during the Phase I investigation: literature and data base review, site inspections, screening activities, and sampling and analysis activities. Review of relevant new literature/information will be performed to evaluate the design of the unit and containment structures and will include a review of any documentation regarding routine visual inspections and/or releases from the IHSSs. Review of existing documentation will be conducted to verify a documented release from IHSS 204 and to confirm that no documented releases have occurred at any of the other OU15 IHSSs. Screening activities include visual inspections and radiological surveys. Site inspections will be performed to further evaluate the conditions of the unit (e.g., identify cracks and drains). Radiological surveys will be performed to make preliminary identification of areas of radiological contamination at the IHSSs. Sampling and analysis activities will be performed to characterize potential contaminants currently present and to evaluate the nature and extent of chemical and radiological contamination at OU15. The activities described below will be performed as part of the field investigation detailed in Section 7.0.

Sampling locations, frequency, and analyses are discussed in the FSP (Section 7.0). All field activities will be performed in accordance with RFP EM Program OPs unless otherwise noted in the FSP.

5.4 TASK 4 - SAMPLE ANALYSIS AND DATA VALIDATION

Analytical procedures will be completed in accordance with the ER Program QAPjP (EG&G, 1991d). Analytical detection limits, sample container and volume requirements, preservation requirements, and sample holding times are discussed in Section 7.3 of the FSP.

Results of data review and validation activities will be documented in data validation reports. EPA data validation functional guidelines will be used for validating organic and inorganic (metals) data (U.S. EPA, 1988b). Data validation methods for radiochemistry and major ions data have not been published by EPA, but data and documentation requirements have been developed by EM Program QA staff. Data validation methods for these data are derived from these requirements. Details of the data validation process are described in the QAPjP (EG&G, 1991e).

Phase I data will be reviewed and validated in accordance with data validation guidelines in the QAPjP and the Data Validation Functional Guidelines (EG&G, 1990a). These documents state that the results of data review and validation activities will be documented in data validation reports.

5.5 TASK 5 - DATA EVALUATION

Data collected during the Phase I RFI/RI will be incorporated into the existing RFEDS data base and will be used to better characterize the nature and extent of contamination associated with OU15. This information will be used in the Human Health Risk Assessment and to determine the need for further action at any of the interim status closure units within OU15.

5.5.1 Site Characterization

The additional physical data collected during Phase I will be incorporated into the existing site characterization. Data will be collected during visual inspection of the sites as well as during the literature review/data base search task of the field investigation. Refined site characterizations will be used to describe contaminant transport pathways inside buildings and to outside areas.

5.5.2 Source Characterization

Analytical data from surface wipe samples, drum samples, and soot samples will be used to:

- Determine the presence or absence of potential contaminants

- Characterize the source of contaminants

- Characterize the extent and concentration of contaminants

Data will be summarized graphically or in tabular format to assist interpretation. Where appropriate, contaminant distribution maps derived from wipe sample analysis will be prepared to illustrate the spatial distribution of contaminants within and near the IHSSs.

5.6 TASK 6 - PHASE I BASELINE RISK ASSESSMENT

As required by the IAG, a Baseline Risk Assessment will be performed as part of the Phase I RFI/RI report. This task is limited to a Baseline Human Health Risk Assessment. An EE specific to OU15 will not be performed. Information obtained during the EE conducted for OU9 will be used in the assessment for OU15 (see Section 9.0). The purpose of the Baseline Human Health Risk Assessment is to assess the potential human health and environmental risks associated with the interim status closure units and to provide a basis for determining whether further action is required and the type of closure necessary for the individual IHSSs. The Baseline Human Health Risk Assessment will address potential worker and public health risks.

Existing data and data collected during the Phase I RFI/RI will be used to support the quantitative Baseline Human Health Risk Assessment. The sampling program will be designed to generate data that meet the requirements set forth in Guidance for Data Useability in Risk Assessment (U.S. EPA, 1990a).

These assessments will aid in the preliminary screening of site remedies based on the contaminants of concern and the environmental media associated with potential risks to public health. The risk assessment process will be accomplished in five general steps:

1. Identification of chemicals of concern
2. Exposure assessment
3. Toxicity assessment
4. Risk characterization
5. Qualitative and quantitative uncertainty analysis

As stated in the IAG, a risk characterization of the following scenarios will be developed:

1. Current site conditions (No Action Alternative)
2. Worker and public exposure during remedial action
3. Past remedy risk

If the results of the Baseline Human Health Risk Assessment indicate that risks posed by contamination at OU15 must be remediated, Tasks 7 (Section 5.7) and 8 (Section 5.8) will be conducted.

The objectives and the description of work for the Baseline Human Health Risk Assessment are described in detail in Section 8.0 of this work plan. The justification for not performing the EE specific to OU15 is discussed in Section 9.0.

5.7 TASK 7 - DEVELOPMENT, SCREENING, AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

Based on the findings of the Phase I RFI/RI, further action may be warranted at all, some, or none of the OU15 IHSSs. If further action is warranted and consists of the development, screening, and detailed analysis of remedial alternatives for environmental media, this activity will be performed as discussed below.

5.7.1 Remedial Alternatives Development and Screening

This section identifies potential technologies applicable to remediation of soils, wastes, surface water, sediments, and ground water potentially contaminated due to radiological and chemical releases at OU15. The identified technologies are based on the preliminary site characterization developed in Section 2.0 and summarized in Section 2.4. Identification and screening of technologies, assembling an initial screening of alternatives, and identification of interim response actions will be conducted while the RFI/RI is being conducted. However, investigation of this operable unit is in its early stages; thus, remedial alternatives are only briefly reviewed in this section. A more detailed evaluation of the remedial alternatives for OU15 will be performed as more data are collected.

The process employed to develop and evaluate alternatives for OU15 will follow guidelines provided in the NCP. Although RCRA regulations will direct remedial investigations at OU15, the CERCLA process will also be considered for guidance because it specifies in greatest detail the steps that should be followed for selection of remedial alternatives. In addition, the IAG requires general compliance with both RCRA and CERCLA guidance.

The steps followed to develop remedial alternatives for the IHSSs within OU15 are as follows:

1. Develop a list of general types of actions appropriate for the IHSSs (such as containment, treatment, and/or removal) that may be implemented to satisfy the objectives defined in the previous step. These general types or classes of actions are referred to as "general response actions" in EPA guidance.

2. Identify and screen technology groups for each general response action. Screening will eliminate groups that are not technically feasible at the site.

3. Identify and evaluate process options for each technology group to select a process option representing each technology group under consideration. Although specific process options are selected to represent a technology group for alternative development and evaluation, these processes are intended to represent the broader range of options within a general technology group.

4. Assemble the selected representative technologies into site closure and corrective action alternatives for the IHSSs within OU15 that represent a range of treatment and containment combinations, as appropriate.

5. Screen the assembled alternatives in terms of the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the purpose of the screening evaluation is to reduce the number of alternatives

that will undergo thorough and extensive analysis, alternatives will be evaluated in less detail than subsequent evaluations.

6. Develop preliminary risk-based remedial action goals for affected media. Preliminary remedial action goals will be applied as performance objectives for evaluating the effectiveness of specific technology processes identified as candidate components of viable remedial action alternatives. Consistent with the NCP, preliminary remediation goals will be established at a 1×10^{-6} excess cancer risk point of departure and at other intervals within the 1×10^{-4} to 1×10^{-6} decision range. As the CMS/FS evolves, preliminary remediation goals may be revised to a different risk level on the basis of consideration of appropriate factors that include, but are not limited to, exposure, uncertainty, and technical issues.

For the Phase I RFI/RI Work Plan, the appropriate level of alternatives analysis is the listing of general response actions most applicable to the type of site under investigation. General response actions are defined as those broad classes of actions that may satisfy the objectives for remediation defined for OU15. Table 5-1 provides a list and description of general response actions and typical technologies associated with remediating soils, wastes, ground water, sediments, and surface water. Table 5-1 also includes a general statement regarding the applicability of the general response action to potential exposure pathways. Not all of the alternative response actions and typical technologies listed may be appropriate for the IHSSs within OU15. Some will be discarded during the screening of alternatives.

The response actions outlined in Table 5-1 must be applied to the potential exposure pathways that will be identified for OU15. The response actions can be capable of providing control over all or some of the potential pathways. Partially effective response actions can be combined to form complementary sets of response actions that provide control over all pathways.

In general terms, potential human exposure can be avoided by prevention of contaminant release, transport, and/or contact. Thus, application of the response actions may be considered at three different points in each potential exposure pathway: (1) at the point where the contaminant could be released from the source, (2) in the transport medium, and (3) at the point where the contact could occur with the released contaminant.

The existing data suggest that releases from the IHSSs to environmental media outside of the buildings have not occurred. The Phase I RFI/RI will generate data necessary to characterize the primary source (as defined in Section 2.0). Data obtained from the investigation will:

- Describe the physical characteristics of the site
- Define sources of contamination
- Determine the nature and extent of contamination
- Describe contaminant fate and transport
- Describe receptors

If further action is required at OU15, the information presented in the Phase I RFI/RI will be used for the preliminary screening of alternatives and a thorough, comparative evaluation of the technologies with respect to implementability, effectiveness, and cost. This information will allow for informed decisions to be made with respect to the need for further action and/or the selection of preferred technologies should remediation activities be warranted.

5.7.2 Detailed Analysis of Remedial Alternatives

Sufficient data may not be generated during the Phase I investigation to allow for a detailed analysis of alternatives; however, this is not a requirement of the Phase I RFI/RI. The detailed analysis of each alternative may be performed if further action is required. The detailed analysis and selection of alternatives is not a decision-making process; rather, it is the process of analyzing and comparing relevant information in order to select a preferred remedial action. Each appropriate alternative will be assessed in terms of nine evaluation criteria, and the assessments will be compared to identify the key attributes among the alternatives. Assessment in terms of nine evaluation criteria is necessary for the CMS and the subsequent Corrective Action Decision (CAD)/Record of Decision (ROD). The nine specific evaluation criteria are as follows:

1. Overall protection of human health and the environment
2. ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume

5. Short-term effectiveness

6. Implementability

7. Cost

8. State acceptance

9. Community acceptance

These criteria are described in recently revised guidelines provided in the NCP. The first two criteria are considered threshold criteria because they must be evaluated before further consideration of the remaining criteria. The next five criteria are considered the balancing criteria on which the analysis is based. The final two criteria are addressed during the final decision-making process after completion of the CMS/FS.

5.8 TASK 8 - TREATABILITY STUDIES/PILOT TESTING

If further action is warranted at OU15 based on the Phase I RFI/RI and that action requires treatability studies and pilot testing to support treatment alternatives, these activities will be performed as discussed below.

The primary purposes of a treatability study are to provide sufficient technology performance information and to reduce cost and performance uncertainties to acceptable levels so that treatment alternatives can be fully developed and evaluated during detailed analysis. The task includes efforts to evaluate whether treatability studies are necessary and, if so, to prepare for and conduct treatability studies. If remedial alternatives are developed, the data collected as part of the field investigation will be reviewed in terms of whether the alternatives can be evaluated. If additional data are required, treatability studies or field investigations will occur.

If it is determined that a treatability study is necessary, a treatability work plan will also be prepared. The plan will identify treatability tests that need to be conducted as well as the test materials and equipment needed.

The treatability work plan will discuss the following:

- The scale of the treatability study
- Key parameters to be varied and evaluated, and criteria to be used to evaluate the tests
- Specifications for test samples and the means for obtaining these samples
- Test equipment and materials and procedures to be used in the treatability test
- Identification of where and by whom the tests and any analytical services will be conducted, as well as any special procedures and permits required to transport samples and residues and conduct the test
- Methods required for residue management and disposal
- Any special QA/QC needed for the tests

5.9 TASK 9 - PHASE I RFI/RI REPORT

An RFI/RI report will be prepared to consolidate and summarize the data obtained during the Phase I fieldwork as well as data collected from previous and ongoing investigations. This report will:

- Describe the field activities that served as a basis for the Phase I RFI/RI report, including any deviations from the work plan that occurred during implementation of the field investigation.

- Discuss site physical conditions based on existing data and data derived during the Phase I RFI/RI. This discussion will include (1) design, construction, and current conditions of the units; and (2) environmental site conditions (e.g., surface features, climate, surface water hydrology, surficial geology, stratigraphy, ground water hydrology, demography and land use, and ecology).

- Present site characterization results from all Phase I RFI/RI activities to characterize the site physical features and contamination associated with OU15 IHSSs. Information obtained during the OU9 EE will be used to address biota in OU15 (see Section 9.0).

- Discuss contaminant fate and transport based on existing information. This discussion will include a preliminary identification of potential contaminant migration routes, and a discussion of contaminant persistence, chemical attenuation processes, and potential receptors.

- Present a Phase I Baseline Risk Assessment. The risk assessment will include a Human Health Risk Assessment and an Environmental Evaluation (based on the OU9 Environmental Evaluation).

- Present a summary of findings and conclusions, including recommendations for further action at each IHSS within OU15.

- Identify data needs for Phase II of the RFI/RI, if further action is necessary.

Table 5-1: Response Actions, Typical Associated Remedial Technologies, and Evaluation

General Response Action	Description	Typical General Response Technologies	Action to Potential Pathways
No Action	No remedial action taken at site	Some monitoring and analyses may be performed.	National Contingency Plan requires consideration of no action as an alternative. Would not address potential pathways, although existing access restriction would continue to control onsite contact.
Access and use restrictions	Permanent prevention of entry into contaminated area of site. Control of land use.	Site security; fencing; deed use restrictions; warming signs.	Could control onsite exposure and reduce potential for offsite exposure. Site security fence and some signs are in place. Additional short-term or long-term access restrictions would likely be part of most remedial actions.
Containment	In-place actions taken to prevent migration of contaminants.	Capping; groundwater containment barriers; soil stabilization; enhanced vegetation.	If applied to source, could be used to control all pathways. If applied to transport media, could be used to mitigate past releases (except air).
Pumping	Transfer of accumulated subsurface or surface contaminated water, usually to treatment and disposal.	Groundwater pumping; leachate collection; liquid removal from surface impoundments.	Applicable to leachate removal prior to in situ treatment or waste removal. Applicable removal of contaminated groundwater and bulk liquids (for example, from buried drums).
Removal	Excavation and transport of primarily nonaqueous contaminated material from area of concern to treatment or disposal area.	Excavation and transfer of drums, soils, sediments, wastes, contaminated structures.	If applied to source, could be used to control all pathways. If applied to transport medial, will control corresponding pathway. Must be used with treatment or disposal response actions to be effective.

General Response Action	Description	Typical General Response Technologies	Action to Potential Pathways
Treatment	Application of technology to change the physical or chemical characteristics of the contaminated material. Applied to material that has been removed.	Solidification; biological, chemical, and physical treatment.	Applied to removed source material; could be used to control all pathways. Applied to removed transport medial, could control air, surface water, groundwater, and sediment pathways.
In Situ Treatment	Application of technologies in situ to change the in-place physical or chemical characteristics of contaminated material.	In situ vitrification; bioremediation.	Applied to source, could be used to control all pathways. Applied to transport medial, could be used to control corresponding pathways.
Storage	Temporary stockpiling of removed material in a storage area or facility prior to treatment or disposal.	Temporary storage structures.	May be useful as a means to implement removal actions, but definition would not be considered a final action for pathways.
Disposal	Final placement of removed contaminated material or treatment residue in a permanent storage facility.	Permitted landfill; repositories.	With source removal, could be used to control all pathways. With removal of contaminated transport medial, could be used to control corresponding pathway (except air).
Monitoring	Short- and/or long-term monitoring is implemented to assess site conditions and contamination levels.	Sediment, soil, surface water, and groundwater sampling and analysis.	RCRA requires post-closure monitoring to assess performance of closure and corrective action implementation.

Approved by:

_____________________ __/__/__ _____________________ __/__/__

Manager, Remediation Programs RFI Project Manager

6.0 SCHEDULE

The schedule for conducting the Phase I RFI/RI is summarized in Figure 6-1. Dates shown are from the IAG, dated January 22, 1991. According to the schedule, approximately two years will elapse from the time this work plan is finalized until the Phase I RFI/RI report is issued.

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT 15
INSIDE BUILDING CLOSURES

ACTIVITY		START	FINISH
PROJECT MANAGEMENT		05 May 92	04 Jan 95
TASK 1	PROJECT PLANNING	05 May 92	01 Mar 93
TASK 2	COMMUNITY RELATIONS	05 May 92	04 Jan 95
TASK 3	FIELD INVESTIGATION	01 Mar 93	01 May 93
TASK 4	SAMPLE ANALYSIS & DATA VALIDATION	01 Apr 93	01 Aug 93
TASK 5	DATA EVALUATION	01 Aug 93	01 Nov 93
TASK 6	BASELINE RISK ASSESSMENT	01 Oct 93	01 Feb 94
TASK 7	PHASE I RFI/RI REPORT	01 Apr 94	04 Jan 95

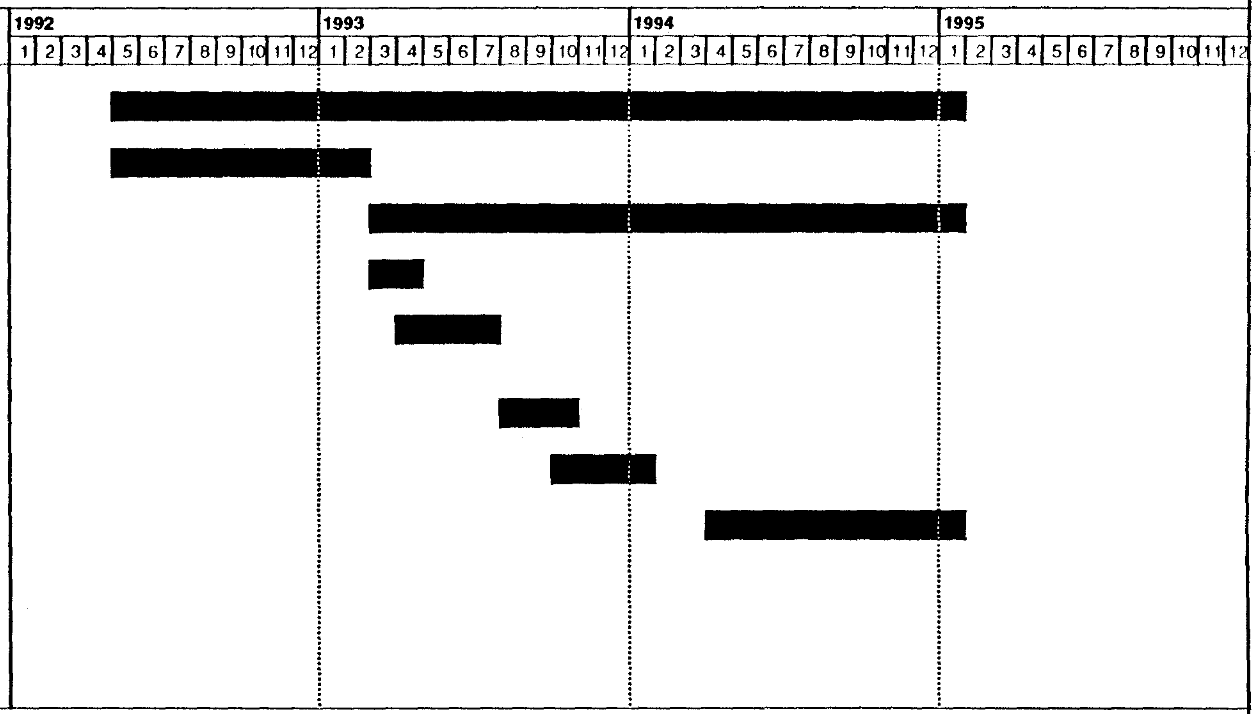

FIGURE 6-1 PHASE I RFI/RI SCHEDULE - OU 15

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Approved by:

_____________________ __/__/__ _____________________ __/__/__

Manager, Remediation Programs RFI Project Manager

7.0 FIELD SAMPLING PLAN

The purpose of this section of the work plan is to provide an FSP that will generate sufficient and adequate data to satisfy the Phase I RFI/RI objectives developed in Section 4.0. These site-specific objectives are presented in Section 7.1. Current site conditions and a discussion of the rationale for the sampling and analysis activities needed to obtain the necessary data to meet the Phase I objectives are summarized in Section 7.2.

Following the discussion of sampling activities (design, location, and frequency) proposed to meet the Phase I RFI/RI objectives (Section 7.3), the sample analysis program (sample designations, analytical requirements and rationale, sample containers and preservations, sample labeling and documentation, and data reporting requirements) and field quality control procedures are discussed in Section 7.4.

The IHSSs comprising OU15 are all located within buildings. The buildings provide, at a minimum, secondary containment, and in some cases, tertiary containment with respect to spills and/or other potential releases of compounds stored or used in these IHSSs. This FSP provides techniques that will assess the nature and extent of potential contamination, present at, or resulting from the IHSSs. This information will be used to determine the need for further action for IHSSs within OU15 including the sampling of potentially contaminated environmental media associated with OU15. No environmental media (soils, sediments, surface water, and ground water) will be sampled under this Phase I RFI/RI.

7.1 OU15 PHASE I RFI/RI OBJECTIVES

The specific objectives of the Phase I RFI/RI field investigation for OU15 are as follows:

Characterize Site Physical Features

(1) Evaluate construction and physical features of the IHSSs and secondary containment systems

(2) Further evaluate the condition of the units and secondary containment systems

Define Contaminant Sources

(1) Identify and characterize wastes historically stored/processed at the IHSSs

(2) Further characterize wastes currently stored at the units (if present)

(3) Determine the presence or absence of contamination within the IHSSs

Determine Nature and Extent of Contamination

(1) Determine the spatial distribution of contaminants related to the IHSSs

Describe Contaminant Fate and Transport

(1) Assess current condition of secondary containment systems at each IHSS

(2) Evaluate potential migration pathways from each IHSS to environmental media outside of the buildings

Provide a Baseline Risk Assessment

(1) The objectives of the Baseline Risk Assessment are discussed in Sections 8.0 and 9.0.

7.2 BACKGROUND AND FSP RATIONALE

Previous investigations performed at OU15 and other pertinent information are described in Section 2.0 of this work plan. To summarize, numerous investigations have been performed previously, which have characterized the environmental setting (Section 2.2) of the buildings in which OU15 IHSSs are located. These investigations primarily include RFI/RI work plans designed to assess known and potential contamination associated with OUs adjacent to OU15 (specifically OUs 1, 2, 4, 5, and 9). Relevant information from these work plans include stratigraphic logs, geotechnical studies, ground water level measurements, results of aquifer tests, and analytical data for ground water, surface water, and borehole samples collected near OU15. Environmental data from these and other OUs near OU15 were evaluated for applicability and useability in assessing potential contamination of environmental media outside of the buildings by wastes associated with OU15. The environmental data are not considered directly relevant to OU15 and, therefore, have not been used in designing this FSP.

Available information directly related to OU15 includes operational site histories, IHSS closure plans, and analytical data for waste materials stored in some the OU15 IHSSs. As noted previously, available IHSS site histories have been examined in preparation of this work plan. The analytical data for characterization of the drummed wastes in OU15 IHSSs (Section 2.2) have not been validated. Although these data are considered qualitative, they have been considered in the design of this FSP.

The types of sampling proposed for this Phase I RFI/RI by this FSP are generally non-intrusive (e.g., surface radiological monitoring and surface wipe samples to be analyzed for radioactivity, VOCs, and metals). Samples of building materials on which drummed wastes were stored will not be obtained, as it has been reported through personal communications with plant operators that some of the floors in these rooms may have been painted to designate radiologically elevated areas. The epoxy paint used effectively seals the radiation, preventing worker exposure. Penetration of painted areas may result in releasing radioisotopes, effectively contaminating the room, RFI/RI investigators, and other workers.

Analytical Rationale

The rationale for the analytical suites appropriate for the various samples obtained from the different areas within OU15 is based on historical information (types of contamination and waste management practices) and the available chemical data of individual contaminants within the physical setting at OU15.

Based on historical records, the primary contaminants of concern that are likely to be present at each of the IHSSs are listed below:

IHSS 178 - radionuclides, Freon TF, and 1,1,1-trichlorethane.

IHSS 179 - radionuclides, chlorinated solvents, beryllium, Freon TF, 1,1,1-trichlorethane, and carbon dioxide.

IHSS 180 - uranium, radionuclides, beryllium, Freon TF, 1,1,1-trichlorethane, and carbon dioxide.

IHSS 204 - uranium, solvents, Freon TF, and 1,1,1-trichlorethane.

IHSS 211 - radionuclides, carbon tetrachloride, acetone, methyl alcohol, butyl alcohol, and various TAL metals.

IHSS 217 - aqueous cyanide solutions.

The analytical programs for each IHSS in OU15 were developed based on the type of constituents suspected to be present at each site. The specific analytes and detection/quantitation limit are specified by reference to CLP analyses. The GRRASP (EG&G, 1991d) provides a listing of CLP analytes and limits that will be used for this Phase I RFI/RI. These analytes and limits are presented in Table 7-1. The program shown in Table 7-1 should address the bulk of chemicals and compounds that were handled, stored, or suspected to be present at OU15 and enable detection of surficial contamination, if present. The detection limits are applicable to wipe samples and samples obtained from drums and containers.

Surface contamination surveys will be performed to indicate the level of removable and fixed alpha and beta-gamma radiation. Surface wipe samples will be obtained from IHSSs 178, 179, 180, 204, and 211 and analyzed for TCL VOCs. Wipe samples obtained from IHSS 179 and IHSS 180 will also be analyzed for beryllium. Wipe samples obtained from

IHSS 211 will be analyzed for TAL metals and TCL VOCs. Wipe samples obtained from IHSS 217 will be analyzed for cyanide.

If drums are present at any of the drum storage areas during implementation of the Phase I RFI/RI, the contents of the drums will be sampled and analyzed for some or all of the following compounds: uranium 233/234, 235, 236, and 238, transuranic elements (plutonium and americium), TAL metals, and TCL volatile organics. However, it is expected that all stored drums will be removed from the IHSSs by November 8, 1992, therefore it is not likely that samples of drum contents will be obtained for this investigation.

Detection limits proposed for these analytical parameters are listed in Table 7-1.

Sampling Strategy and Rationale

This section describes the Phase I investigation sampling strategy and rationale for the IHSSs within OU15. For each IHSS, the tasks listed are generally divided into the following three separate steps.

- Step 1 consists of a review of new and/or additional data. Although review and evaluation of available data relative to OU15 has been performed during the preparation of this Phase I work plan, data obtained from ongoing or other operable unit investigations that have become available since the preparation of this Phase I work plan will also be compiled, reviewed, and evaluated. These data will be validated as appropriate for incorporation into the characterization of the OU15 site. These data may include waste characterization information from the WSIC Report for Building 881, unit design and construction drawings, and information related to releases from the units.

- Step 2 involves field screening activities, including visual inspections and surface radiation surveys. Visual inspections will be performed to more completely assess the configuration of the units and the conditions of the floors with respect to cracks and/or worn areas that might represent contaminant pathways, the slopes of the floors, and the presence of sumps or drains. Visual inspections will be performed prior to sampling activities. The radiation surveys are designed to provide screening-level data (EPA Level II data) concerning the presence or absence of surface radiological contamination.

- Step 3 consists of Phase I sampling activities of surface materials. Wipe samples and soot samples will be collected and analyzed. If drums are present at the units, samples of the contents of each drum will be obtained and analyzed. These activities will provide EPA Level IV and V analytical data.

The Phase I investigation programs for each area are summarized below. A number of Environmental Management Division (EMD) Operating Procedures will be used during the investigation. The Operating Procedures are cited in this section and discussed further in Section 11.0 of this Phase I work plan.

7.3 SAMPLING DESIGN, LOCATION, AND FREQUENCY

The sampling activities to be performed at each IHSS are outlined below and discussed in detail in Sections 7.3.1 through 7.3.3. Sampling activities are also summarized in Table 7-2.

IHSS 178 - Building 881 Drum Storage Area - Room 165

- Review of new data and information
- Visual inspection
- Sampling and analysis of drum contents (if present)
- Surface radiological surveys for fixed and removable alpha and beta-gamma radiation
- Wipe sampling

IHSS 179 - Building 865 Drum Storage Area - Room 145

- Review of new data and information;
- Visual inspection;
- Sampling and analysis of drum contents (if present)
- Surface radiological surveys for fixed and removable alpha and beta-gamma radiation
- Wipe sampling

IHSS 180 - Building 883 Drum Storage Area - Room 104

- Review of new data and information;
- Visual inspection;
- Sampling and analysis of drum contents (if present)
- surface radiological surveys for fixed and removable alpha and beta-gamma radiation
- Wipe sampling

IHSS 204 - Unit 45, Original Uranium Chip Roaster - Building 447 - Room 502

- Review of new data and information;
- Visual inspection;
- Sampling and analysis of drum contents (if present)
- Surface radiological surveys for fixed and removable alpha and beta-gamma radiation
- Soot sampling
- Wipe sampling

IHSS 211 - Building 881 Drum Storage Area - Room 266B

- Review of new data and information;
- Visual inspection;

- Sampling and analysis of drum contents (if present)
- Surface radiological surveys for fixed and removable alpha and beta-gamma radiation
- Wipe sampling

IHSS 217 - Unit 32, Cyanide Bench Scale Treatment - Building 881 - Room 131C

- Review of new data and information;
- Visual Inspection;
- Sampling of liquid in polyethylene bottles
- Surface radiological surveys for fixed and removable alpha and beta-gamma radiation
- Wipe sampling

7.3.1 Review of New Data and Information

Data obtained since the preparation of this work plan will be reviewed and evaluated, as appropriate, for characterization of IHSSs 178, 179, 180, 204, 211, and 217. This may include additional waste stream identification and characterization information, construction diagrams indicating the thickness of the concrete on which the drums are stored, data from the sitewide programs, and data obtained from other OU investigations. Chemicals identified by the WSIC program as being stored in the IHSSs will be evaluated with respect to their environmental fate and transport characteristics. Evaluation of new data may result in modifications to the sampling activities and/or analytical suites for the Phase I RFI/RI.

7.3.2 Visual Inspections and Surface Radiation Surveys

Visual inspections will be performed at IHSS 178, 179, 180, 204, 211, and 217 prior to any other site work. The inspections will consist of inspecting the area to confirm details that were observed during the initial site visit, such as; number and condition of drums currently being stored, the condition of the concrete floor, the slope of the concrete floor, the presence of sumps or drains, the condition of the Original Uranium Chip Roaster, the condition of the laboratory table and metal fume hood at the Unit 32, Cyanide Bench Scale Treatment, and other features and materials that could impact the IHSS or sampling that will be conducted during this investigation. The results of the site inspections will be plotted on detailed sketches of the units. If drums are currently being stored, samples will be obtained from the contents of the drums, and the drums will be moved prior to additional sampling activities. If the polyethylene bottle(s) at IHSS 217 contain wastes, samples will be obtained for analysis.

Radiation surveys will be performed over the surface of the areas affected by drum storage operations at IHSS 178, 179, 180, 204, and 211. Radiation surveys will also be performed over the metal surfaces of the Original Uranium Chip Roaster at IHSS 204 and the metal surfaces of the laboratory table and fume hood of the Cyanide Bench Scale Treatment Unit. The surveys will determine removable and total (fixed) radioactive surface contamination. The direct radiation readings will be obtained on a 1-foot grid. Wipe samples will be obtained from large areas, such as floors, by dividing the surface into 1-square meter (m^2) areas and wiping each 1 m^2, resulting in one sample per 1 m^2. Wipe samples will be obtained from small areas, such as the metal surfaces of the Original Uranium Chip Roaster and the flume containing the Cyanide Bench Scale Treatment Unit, by dividing the surface into 100-square centimeter areas and wiping each 100 cm^2, resulting in one sample per 100

cm^2. All wipe samples will be obtained according to the procedures described in EMD Operating Procedure 1.16 (Field Radiological Measurements), EM Radiological Guidelines 3.1 R.O. (Performance of Surface Contamination Surveys) and and a applicable DCNs. If readings above background are detected near the existing boundary of the IHSSs, the survey grids will be expanded past the existing boundary. Background levels of radioactivity as measured by the various types of instrumentation are listed in the appropriate EMD Operating Procedures. The results of the surveys will be plotted on a sketch of the IHSS and documented on the appropriate forms as specified by the Operating Procedures. The Phase I survey will be conducted using a high-purity germanium detector (HPGD). Smear counting will be performed with an Eberline SAC-4 Alpha-Scintillation Smear Counting Instrument and a Eberline BC-4 Beta Smear Counting Instrument.

7.3.3 Sampling Activities

Drum sampling

If drums are present when this Phase I investigation is being conducted, samples will be obtained from the materials inside the drums. The method of sampling will vary depending on the degree of access to the drummed material. Ideally, several samples will be obtained from locations displaced both vertically and horizontally throughout the drum. Drum sampling will be performed in accordance with a Drum Sampling Operating Procedure currently being used by RFP Waste Management for characterization of RCRA-regulated drummed wastes. Depending on the drum type and waste type, one of the following sampling approaches will be used.

Open-top containers containing solid wastes will be sampled using the three-dimensional random sampling method. This method involves dividing the surface of the waste into a grid of four equal areas and the height of the container will be divided into two levels from top to bottom. Specific levels and grid locations will then be selected for sampling using a random number table.

Closed containers with restricted openings or open top drums containing liquids, slurries, sludges, and powders or granules will be sampled using the two dimensional sampling method. This method involves dividing the surface into four equal areas, selecting the grid locations to be sampled with a random number table, and sampling each selected grid point along the entire vertical profile of the waste.

Drums with bung openings limit the sampling to obtaining a sample from the entire vertical profile of the waste at the point of access with a drum thief (a glass tube). The following general procedures will be followed when sampling with a drum thief:

1. The glass tube will be slowly lowered into the waste so that the level of the liquid inside the tube remains the same as the level in the drum.

2. Once the sampler is at the bottom of the drum, the top of the tube will be covered with a thumb or a stopper to create a seal.

3. The drum thief will be withdrawn from the drum and the outside of the tube will be wiped with a disposable towel.

4. The bottom of the drum thief will be inserted into an appropriate sample container. The seal will be released causing the sample to flow into the sample container.

5. After the appropriate volume of waste has been obtained, the drum thief will be decontaminated and disposed of per a DCN to EMD Operating Procedure FO.06 (Handling of Personnel Protective Equipment) or the drum thief may be inserted into the drum that was sampled and disposed of with the contents of the drum.

Drums being stored at IHSSs 178, 179, and 180 are reported to contain maintenance oil. It is anticipated that drum sampling will be performed through the bung opening with a drum thief. All drums present at the IHSSs 178, 179, and 180 at the time that this Phase I investigation is being conducted will be sampled. Samples obtained from drums located in IHSSs 178, 179, 180, and 204 will be analyzed for the following analytes: uranium 233/234, 235, 236, and 238, transuranic elements (plutonium and americium), gross alpha, gross beta, TAL metals, and TCL volatile organics.

Drums being stored at IHSS 211 are reported to contain solid waste possibly contaminated with solvents, uranium, and TAL metals, including beryllium. It is anticipated that sampling will be performed through the drum opening. Sampling will be performed using the three dimensional random sampling method. Samples obtained from drums located in IHSS 211 will be analyzed for the following analytes: uranium 233/234, 235, 236, and 238, transuranic elements (plutonium and americium), gross alpha, gross beta, TAL metals, and TCL volatile organics.

All collected samples will be placed in appropriate containers for analytical testing, preserved, stored, and shipped according to procedures specified in EMD Operating Procedure FO.13 (Containerization, Preserving, Handling, and Shipping of Soil and Water Samples).

Sampling of Liquid in Polyethylene Bottles at IHSS 217

If the polyethylene bottles present at IHSS 217 contain liquid solution when the Phase I investigation is being conducted, samples will be obtained from each bottle. Sampling will be performed in accordance with Section 6.3 (Transfer of Samples to Laboratory Containers) of EMD Operating Procedure SW.10 (Event-Related Surface Water Sampling). The samples will be analyzed for cyanide.

All collected samples will be placed in appropriate containers for analytical testing, preserved, stored, and shipped according to procedures specified in EMD Operating Procedure FO.13 (Containerization, Preserving, Handling, and Shipping of Soil and Water Samples).

Wipe Sampling

Wipe samples will be collected from the surface on which the drums were/are stored of IHSSs 178, 179, 180, 204 (drum transfer Rooms 31 and 501), and 211. Wipe sampling consists of rubbing a moistened filter paper over a specified area of the surface being sampled. The filter paper is sent to a laboratory for analysis. The results of the analysis are then related back to the known area of the sample. A procedure for wipe sampling will be developed in accordance with EMD Administrative Procedure 21000-ADM-05.01. Wipe sampling will be performed in accordance with the following general procedures:

1. Using a clean, impervious disposable glove, (i.e., a surgeons glove), remove a filter paper from the box.

2. Moisten the filter paper with organic-free water for TAL metals and beryllium analyses or methanol for VOC analysis. The filter should be wet but not dripping.

3. Thoroughly wipe approximately 1 m^2 or 100 cm^2 (depending on the size of unit being investigated) with the moistened filter paper being sure to wipe any crevices or depressions.

4. Without allowing the filter to contact any other surface, fold the filter with the exposed side in, and then fold it over to form a 90-degree angle in the center of the filter.

5. Place the filter (angle first) into a clean glass sample container. Handle the sample container according to EMD Operating Procedure FO.13 (Containerization, Preserving, Handling, and Shipping Soil and Water Samples).

6. Submit the sample to an offsite laboratory.

The floor surfaces to be sampled at IHSSs 178, 179, 180, 204, and 211 will be divided into 1 m^2 areas. Each 1 m^2 area will be sampled. The samples collected from IHSSs 178, 179, 180, and 204 will be analyzed for TCL VOCs and separate wipe samples will be obtained and analyzed for beryllium. The samples collected from IHSS 211 will be analyzed for TCL VOCs and TAL metals.

Wipe samples will be collected from the inside and outside surfaces of the Original Uranium Chip Roaster (IHSS 204). The surface of the unit will be divided into 100 cm^2 areas. Each 100 cm^2 area will be sampled. The samples will be analyzed for TCL VOCs.

Wipe samples will be collected from the inside and outside surfaces of the metal fume hood in which the Bench Scale Cyanide Treatment Unit is stored (IHSS 217). The surface of the unit will be divided into 100 cm^2 areas. Each 100 cm^2 area will be sampled. The samples will be analyzed for cyanide.

All collected samples will be placed in appropriate containers for analytical testing, preserved, stored, and shipped according to procedures specified in EMD Operating Procedure FO.13 (Containerization, Preserving, Handling, and Shipping of Soil and Water Samples).

Soot Sampling at IHSS 204

Samples of the soot present inside of the Original Uranium Chip Roaster will be obtained and analyzed for VOCs. At this time, the inside of the unit has not been inspected to observe where the buildup of soot, if any, exists. Samples of soot will be obtained using the wipe sampling procedure being developed in accordance with EMD Administrative Procedure 21000-ADM-05.01. If sufficient soot buildup does exist to sample by some other method, an appropriate OP will be used or an appropriate DCN developed for the method.

All collected samples will be placed in appropriate containers for analytical testing, preserved, stored, and shipped according to procedures specified in EMD Operating Procedure FO.13 (Containerization, Preserving, Handling, and Shipping of Soil and Water Samples).

7.4 SAMPLE ANALYSIS

This section describes the sample handling procedures and analytical program for samples collected during the Phase I investigation including sample designations, analytical requirements, sample containers and preservation, and sample handling and documentation.

7.4.1 Sample Designation

All sample designations generated for the RFI/RI will conform to the input requirements of RFEDS. Each sample designation will contain a nine-character sample number consisting of a two-letter prefix identifying the media samples (e.g., "SB" for soil borings, "SS" for surface soils), a unique five-digit number, and a two-letter suffix identifying the contractor. One sample number will be required for each sample generated, including QC samples. In this manner, 99,999 unique sample numbers are available for each sample media for each contractor that contributes sample data to the data base. These sample numbering procedures are consistent with the RFP sitewide QAPjP.

7.4.2 Analytical Requirements

As discussed in Section 7.2, analytical parameters for Phase I are primarily based on operational information regarding waste composition stored at the units and secondarily on the available analytical data resulting from analyses of samples obtained from drums stored at the units. The analytical programs for each area in OU15 were developed based on the type of waste known or suspected to be present at each IHSS. Generally, samples obtained from the drums during the Phase I RFI/RI will be analyzed for some or all of the following chemical and radionuclide parameters:

- TAL metals;
- TCL volatile organics;
- Radionuclides (uranium 233/234, 235, 236, and 238, plutonium 239/240 and americium 241, gross alpha, and gross beta)

Generally, samples obtained from the wipe samples during the Phase I RFI/RI will be analyzed for some or all of the following chemical parameters:

- TCL volatile organics
- TAL metals

Samples obtained form the polyethylene bottles at IHSS 217 will be analyzed for cyanide. Samples of soot obtained from IHSS 204 will be analyzed for VOCs. The specific analytes in the groups listed above and their detection/quantitation limits are contained in Table 7-1.

The specific analytes and detection/quantitation limits are specified by reference to CLP analyses. The GRRASP (EG&G, 1991d) provides a listing of analytes and limits that will be used for this Phase I RFI/RI. Part A of the GRRASP provides HSL analytes and limits using CLP methods. Part B of the GRRASP provides analytes and limits for radionuclides. These analytes and limits are presented in Table 7-1. The program shown in Table 7-1 should address the bulk of chemicals and compounds that were handled or suspected to be present at OU15 and enable detection of surficial contamination, if present.

Uranium is documented to have been a constituent of the wastes at OU15. The isotopes U-233, U-234, U-235, U-236, and U-238 have been selected for analysis in Phase I. Plutonium is the only transuranic element used on the site. Because americium is a daughter product of plutonium, both plutonium and americium have been selected as Phase I radionuclide parameters. Gross alpha and gross beta are included as screening parameters because they are useful indicators of radionuclides. As stated previously, these analyses will only be performed on samples obtained from drummed materials.

7.4.3 Sample Containers and Preservation

Sample volume requirements, preservation techniques, holding times, and container material requirements are dictated by the media being sampled and by the analyses to be performed. The matrices to be analyzed include filter paper used during the wipe sampling and possible drummed waste (oils, liquids, and solid wastes). Analytes of interest in drummed waste, wipes, liquid, and soot samples require the associated container size, preservatives (chemical and/or temperature), and holding times are listed in Tables 7-3 and 7-4. Additional specific guidance on the appropriate use of containers and preservatives is provided in EMD

Operating Procedure FO.13 (Containerization, Preserving, Handling, and Shipping of Soil and Waste Samples).

7.4.4 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and analytical records and reports. Specific guidance defining the necessary sample control, identification, and chain-of-custody documentation is discussed in EMD Operating Procedure FO.13. (Containerization, Preserving, Handling, and Shipping of Soil and Waste Samples).

7.5 DATA MANAGEMENT AND REPORTING REQUIREMENTS

Field data will be input into the RFEDS environmental data base using a remote data entry module supplied by EG&G. Data will be entered on a timely basis and a 3.5-inch diskette will be delivered to EG&G. A hard copy report will be generated from the module for contractor use. The data will be put through a prescribed QC process based on EMD Operating Procedure FO.14 (Field Data Management).

A sample tracking spreadsheet will be maintained by the contractor for use in tracking sample collection and shipment. EG&G will supply the spreadsheet format and will stipulate the timely reporting of the information. This data will also be delivered to EG&G on 3.5-inch diskettes. Computer hardware and software requirements for contractors using government supplied equipment will be supplied by EG&G. Computer and data security will also follow acceptable procedures outlined by EG&G.

7.6 FIELD QC PROCEDURES

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared. Trip blanks will be obtained from the laboratory. The analytical results obtained for these samples will be used by the ER project manager to assess the quality of the field sampling effort. The types of field QC samples to be collected and their application are discussed below. The frequency with which QC samples will be collected and analyzed is provided in Table 7-5.

Duplicated samples will be collected by the sampling team and will be used as a relative measure of the precision of the sample collection process. These samples will be collected at the same time, using the same procedures, the same equipment, and the same types of containers as required for the samples. They will also be preserved in the same manner and submitted for the same analyses as required for the samples.

Field preservation blanks of distilled water, preserved according to the preservation requirements (Section 7.4.3), will be prepared by the sampling team and will be used to provide and indication of any contamination introduced during field sample preparation. As indicated by Table 7-5, these QC samples are applicable only to samples requiring chemical preservation.

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on non-dedicated sampling equipment. Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection. The rinsate is collected and placed in the appropriate sample containers. Equipment rinsate blanks are applicable to all analyses for water and soil samples as indicated in Table 7-5.

Trip blanks consisting of deionized water will be prepared by the laboratory technician and will accompany each shipment of water samples for volatile organic analysis. Trip blanks will be stored with the group of samples with which they are associated. Analysis of the trip blank will indicate migration of volatile organics or any problems associated with the shipment, handling, or storage of the samples. Information from the trip blanks will be used in conjunction with air monitoring data and other information to assess the influence of ongoing waste operations on the quality of data collected.

Requirements for QA of field activities, including visual inspections, radiation surveys, and sampling are specified in Section 10.0 of this work plan..

7.7 AIR MONITORING PROCEDURES

Air monitoring will be performed during field activities to ensure that any ongoing building operations or activities do not adversely affect the quality of data obtained during sampling. Air quality monitoring will be performed in accordance with Operating Procedures presently being developed by EG&G.

None of the field activities proposed in this FSP have a potential for producing appreciable quantities of suspended particulates, therefore local monitoring of Respirable Suspended Particulates (RSP) will not be required.

Table 7-1: Phase I Soil, Sediment, and Liquid Sampling Parameters and Detection Limits

Target Analyte List Metals	Detection Limits Liquid ($\mu g/l$)	Solids/Soil/Sediment (mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1.0
Cadmium	5	1.0
Calcium	5000	2000
Cesium*	1000	200
Chromium	10	2.0
Cobalt	50	10
Copper	25	5.0
Cyanide	10	10
Iron, Total	100	20
Lead	5	1.0
Lithium*	100	20
Magnesium	5000	2000
Manganese	15	3.0
Mercury	0.2	0.2
Molybdenum*	200	40
Nickel	40	8.0
Potassium	5000	2000
Selenium	5	1.0
Silver	10	2.0
Sodium	5000	2000
Strontium*	200	40
Thallium	10	2.0
Tin*	200	40
Vanadium	50	10.0
Zinc	20	4.0

Target Compounds List Volatiles	Liquid ($\mu g/l$)	Solids/Soil/Sediment ($\mu g/kg$)
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
trans 1,2-Dichloroethene (Total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,1,2,2,-Tetrachloroethane	5	5
1,2-Dichloropropane	5	5
trans-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
cis-1,3-Dichloropropene	5	5
Bromoform	5	5
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10
2-Hexanone	10	10
Tetrachloroethene	5	5
Toluene	5	5
1,1,2,2-Tetrachloroethane	5	5

	Liquid ($\mu g/l$)	Solids/Soil/Sediment ($\mu g/kg$)
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Total Xylenes	5	5

Radionuclides	Liquid (pCi/ℓ)	Solids/Soil/Sediment (pCi/g)
Gross Alpha	2	4 dry
Gross Beta	4	10 dry
Uranium 233+234, 235, and 238 (each species)	0.6	0.3 dry
Americium 241	0.01	0.02 dry
Plutonium 239+240	0.01	0.03 dry

* Non-CLP TAL Metals detection limit

NOTE: Detection limits are highly matrix dependent. The limits listed here are the minimum achieveable under ideal conditions. Actual limits may be higher.

TABLE 7-2
SUMMARY OF ACTIVITIES
PHASE I RFI/RI OU15

IHSS	Step 1 Activities	Step 2 Activities - EPA DQO Level I and II data	Step 3 Activities - EPA DQO Level IV data
178	Review of new data and information	Visual Inspection Surface radiological survey - alpha, beta-gamma	Drum sampling - radionuclides, VOCs, TAL metals Wipe samples - VOCs
179	Review of new data and information	Visual Inspection Surface radiological survey - alpha, beta-gamma	Drum sampling - radionuclides, VOCs, TAL metals Wipe samples - VOCs, beryllium
180	Review of new data and information	Visual Inspection Surface radiological survey - alpha, beta-gamma	Drum sampling - radionuclides, VOCs, TAL metals Wipe samples - VOCs, beryllium
204	Review of new data and information	Visual Inspection Surface radiological survey - alpha, beta-gamma	Drum sampling - radionuclides, VOCs, TAL metals Wipe samples - VOCs, Be Soot sampling- VOCs
211	Review of new data and information	Visual Inspection Surface radiological survey - alpha, beta-gamma	Drum sampling - radionuclides, VOCs, TAL metals wipe samples - VOCs, Be, TAL metals
217	Review of new data and information	Visual Inspection Surface radiological survey - alpha, beta-gamma	Polyethylene bottle sampling - cyanide Wipe samples - cyanide

Table 7-3: Sample Containers, Sample Preservation, and Sample Holding Times for Water/Liquid Samples

Parameter	Container	Preservative	Holding Time
Liquid - Low to Medium Concentration Samples			
Organic Compounds:			
Purgeable Organics (VOCs)	2 x 40-mℓ VOA vials with teflon-lined septum lids	Cool, 4°C[a] with HCL to pH<2	7 days 14 days
Extractable Organics (BNAs), Pesticides and PCBs	1 x 4-ℓ amber[b] glass bottle	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 1-ℓ polyethylene bottle	Nitric acid pH<2; Cool, 4°C	180 days[c]
Cyanide	1 x 1-ℓ polyethylene bottle	Sodium hydroxide[d] pH>12; Cool, 4°C	14 days
Anions	1 x 1-ℓ polyethylene bottle	Cool, 4°C	14 days
Sulfide	1 x 1-ℓ polyethylene bottle	1 mℓ-zinc acetate sodium hydroxide to pH>9; Cool, 4°C	7 days
Nitrate	1 x 1-ℓ polyethylene bottle	Cool, 4°C	48 hours
Total Dissolved Solids (TDS)	1 x 1-ℓ polyethylene bottle	Cool, 4°C	48 hours
Radionuclides	1 x 1-ℓ polyethylene bottle	Nitric acid pH<2;	180 days

[a]Add 0.008% sodium thiosulfate (Na2S2O3) in the presence of residual chlorine.

[b]Container requirement is for any or all of the parameters given.

[c]Holding time for mercury is 28 days.

[d]Use ascorbic acid only if the sample contains residual chlorine. Test a drip of sample with potassium iodine-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6g of ascorbic acid for each liter of sample volume.

Table 7-4: Sample Containers, Sample Preservation, and Sample Holding Times for Solid/Soil/Sediment Samples

Parameter	Container	Preservative	Holding Time
Soil or Sediment Samples - Low to Medium Concentration			
Organic Compounds:			
Purgeable Organics (VOCs)	1 x 4-oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days 14 days
Extractable Organics (BNAs), Pesticides and PCBs	1 x 8-oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 8-oz wide-mouth glass jar	Cool, 4°C	180 days[1]
Cyanide	1 x 8-oz wide-mouth glass jar	Cool, 4°C	14 days
Sulfide	1 x 8-oz wide-mouth glass jar	Cool, 4°C	28 days
Nitrate	1 x 8-oz wide-mouth glass jar	Cool, 4°C	48 hours
Radionuclides	1 x 1-ℓ wide-mouth glass jar	None	45 days

[1]Holding time for mercury is 28 days.

Table 7-5: Field QC Sample Frequency

Sample Type	Type of Analysis	Media: Solids	Media: Liquids
Duplicates	Organics	1/10	1/10
	Radionuclides	1/10	1/10
	Inorganics	1/10	1/10
Field Preservation Blanks	Organics	NA	NA
	Radionuclides	NA	1/20
	Inorganics	NA	1/20
Equipment Rinsate Blanks*	Organics	1/20	1/20
	Radionuclides	1/20	1/20
	Inorganics	1/20	1/20
Trip Blanks	Organics	NR	1/20
	Radionuclides	NR	NR
	Inorganics	NR	NR

NA = Not Applicable
NR = Not Required
1/10 = one QC sample per ten samples collected

* Equipment rinsate blanks will be collected at a minimum of 1/20 or once per day of sampling, whichever is more frequent.

Approved by:

____________________ __/__/__ ____________________ __/__/__

Manager, Remediation Programs RFI Project Manager

8.0 HUMAN HEALTH RISK ASSESSMENT PLAN

8.1 OVERVIEW

In accordance with the IAG, the Phase I RFI/RI will characterize contamination at, or resulting from, the IHSSs comprising OU15. Based on the findings of the Phase I RFI/RI Report, if the agencies determine that (1) there has been no historical releases external to the units and (2) there is no threat of post-closure releases, then no further action will be required. Under these circumstances a Baseline Risk Assessment will not be performed. However, if residual contaminants are identified at an OU15 IHSS during the Phase I RFI/RI, a Baseline Risk Assessment will be performed for that IHSS as discussed below.

Section 300.430(d) of the National Contingency Plan states that as part of the remedial investigation, a Baseline Risk Assessment is to be conducted to determine whether contaminants of concern identified at the site pose a current or potential future risk to human health (Human Health Risk Assessment) and the environment (Environmental Evaluation) in the absence of remedial action. This section describes the Human Health Risk Assessment components, which include:

- Data Collection/Evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization.

The EE is described in Section 9.0 of this Work Plan.

Figure 8-1 illustrates the basic Human Health Risk Assessment process and components. The Human Health Risk Assessment objective is to identify and assess potential human health risks resulting from exposure to site contaminants present in various environmental media. Several objectives will be accomplished under the Human Health Risk Assessment task, including identification and characterization of the following:

- Toxicity and levels of hazardous substances present in relevant media (e.g., building materials, air, ground water, soil, surface water, sediment, and biota)
- Environmental fate and transport mechanisms within building materials and specific environmental media, and inter-media fate and transport where appropriate
- Potential human and environmental receptors

- Potential exposure routes and extent of actual or expected exposure

- Extent of expected impact or threat, and the likelihood of such impact or threat occurring (e.g., risk characterization)

- Level(s) of uncertainty associated with the above.

Human Health Risk Assessment results will be used to determine if remedial actions are warranted at OU15 and, if so, the associated cleanup levels and type of closure necessary to protect human health.

A number of EPA guidance documents will be used to provide direction for developing the Human Health Risk Assessment. The documents listed in Table 8.1 constitute the most recent EPA guidance in public health risk assessment. It must be emphasized that EPA manuals are guidelines only, and that EPA states that considerable professional judgement must be used in their application. The focus of the risk assessment for OU15 will be to produce a realistic analysis of exposure and health risk.

To accomplish the characterization of the magnitude of the exposure/dose assessment for radionuclides, a number of documents will be referenced, including but not limited to DOE Order 5400.5, Federal Guidance Report No. 10 (U.S. EPA, 1984), and Federal Guidance Report No. 11 (U.S. EPA, 1988c). The dose calculations shall provide an estimate of the committed effective dose equivalent to an individual in the population which can then be compared to lifetime risk from radiation exposure. Estimates of lifetime risk of cancer to exposed individuals resulting from radiological and chemical risk assessments will be tabulated separately in the final human health risk assessment. In addition to available national EPA guidance, supplemental Region VIII risk assessment guidance will be used if applicable.

The following Human Health Risk Assessment Plan will be applicable to the Phase I RFI/RI tasks undertaken at OU15. Phase I RFI/RI objectives include characterization of the nature and extent of contamination at, or resulting from, OU15 IHSSs and a determination of the need for further action. In accordance with the IAG, if it is determined that a release from an IHSS has not occurred and no further action is warranted, a Human Health Risk Assessment will not be performed. If a release from an IHSS has occurred, a Human Health Risk Assessment will be performed. The results of the assessment will be used to determine whether further action is warranted. As described in Section 2.5.4, the limited scope of Phase I data collection will support quantitative evaluation of soil ingestion, inhalation, and dermal contact exposure pathways. These pathways will be evaluated at locations where contamination is determined to exist due to OU15 IHSS releases. Phase I will also allow identification of potential exposure pathways involving surface water, ground water, and biota as transport media. The need for further evaluation of these pathways will be quantitatively evaluated, if necessary, during Phase II.

The Phase I characterization must meet the applicable data needs and data usability described in this section. Existing available information on building materials, ground water, surface water, and air quality will be incorporated to the extent practicable. This information can then be applied to each component of the risk assessment process, and a partial Human Health Risk Assessment will be developed.

8.2 DATA COLLECTION/EVALUATION

This section outlines the process that will be used to identify source-related contaminants present at OU15 at concentrations that could be of concern to human health. This process includes a summary of historical and RFI/RI related data collected at OU15, an evaluation of historical and RFI/RI data relevant to performing the Human Health Risk Assessment, and use of this information to identify contaminants of concern (COCs). COCs include chemicals and other constituents, such as metals or radionuclides, that are identified at the unit and evaluated in the Human Health Risk Assessment.

8.2.1 Data Collection

The first step in the process is a summary of all data available for use in the Human Health Risk Assessment. This step identifies the historical data relevant to performing the Human Health Risk Assessment, assembles Phase I RFI/RI data as they become available, and establishes data formats to facilitate data evaluation. Data attributes important to this step include the following information:

- Site description
- Sample design with sampling locations
- Analytical method and detection limit
- Results for each sample, including qualifiers

- Sample quantitative limits and/or detection limits for non-detects
- Field conditions.

8.2.2 Data Evaluation

Historical and Phase I RFI/RI data will be further evaluated in part by EPA's guidelines issued in *Guidance for Data Useability in Risk Assessment* (U.S. EPA, 1990a). Internal EG&G QA/QC guidelines will also be used to evaluate the usability of historical data available. EPA has identified the following data useability criteria:

- Assess data documentation for completeness
- Assess data sources for appropriateness and completeness
- Assess analytical methods and detection limits for appropriateness
- Assess data validation review
- Assess sampling data quality indicators (completeness, comparability, representativeness, precision, and accuracy)

- Assess analytical data quality indicators (such as spike recoveries, duplicates, and blanks) for completeness, comparability, representativeness, precision, and accuracy.

Following completion of the Phase I RFI/RI data collection, analysis, and validation, new data will be evaluated to determine if the Phase I RFI/RI data that can be used to support a quantitative Human Health Risk Assessment will be identified. Part of this evaluation will include the most appropriate summary process and format. This will involve identifying statistical summary techniques that consider spatial and temporal data distributions, determining if arithmetic or geometric means are appropriate, and determining the appropriate method for dealing with non-detected values and qualified data. The data summary will include:

- The frequency of detection (number of positive detects/number of analyses) for each compound and sample location

- The minimum- and maximum-reported concentrations for each compound at each sample location

Tentatively identified compounds (TICs) reported in the Phase I RFI/RI data will be evaluated relative to their usefulness in the Human Health Risk Assessment. If only a few TICs are reported relative to other contaminants, or if they are unrelated to the RFP, they will be excluded from the Human Health Risk Assessment. If numerous TICs are reported and they appear related to the RFP, they will be carried through the Human Health Risk Assessment only to the extent that they aid in characterizing human health risk as needed for site decisions. It is unlikely that risks resulting from exposure to TICs cannot be characterized at this time because of the absence of specific contaminant identity and available toxicological information.

8.2.3 Hazard Identification

The objective of the hazard identification is to identify RFP-related COCs present at OU15 in concentrations high enough that may be of concern relative to human health considerations. Criteria for performing the hazard identification include but may not be limited to:

- Frequency of detection
- Concentrations in environmental media concentrations exceed background
- Toxicity, mobility, and persistence

From the list of valid data suitable for use in the risk assessment, potential site-specific COCs may be identified based on the following considerations:

- The chemical is identified as a site-specific, waste activity related compound released from an identified source at the IHSS
- The concentration of the chemical exceeds the chemical-specific ARARs

- The chemical is detected at a frequency greater than 5 percent of the time in an individual media (e.g., surface soil, subsurface soil, alluvial ground water, etc.)

- The concentration of the chemical exceeds the 95 percent Upper Tolerance Limit of the background concentration estimate

- The chemical is a potential carcinogenic compound classified as: Group A - sufficient evidence of carcinogenicity in humans, Group B1 - limited evidence of carcinogenicity in humans, and Group B2 - sufficient evidence in animals with inadequate evidence in humans

- The occurrence of a non-carcinogenic compound in media at a concentration 0.1 times the derived media concentration (DMC). (The DMC equals the exposure dose divided by the reference dose.)

- The chemical's inter-media transport, persistence, and biometabolic characteristics

- The chemical's role as a nutrient

Depending on the number of site-related contaminants identified, one of two things will happen under both current and potential future conditions:

1. If only a few site-related contaminants are identified, all of them will be carried through the risk assessment. The contaminants responsible for dominant risks at the site, as well as those contributing lower risk, will be identified.

2. If a large number of site-related contaminants are identified, contaminants of concern may be selected and carried through the risk assessment to characterize only those expected to contribute the highest risk. contaminants of concern will then be selected in accordance with the Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (U.S. EPA, 1989b) that requires the following:

   - Evaluating site historical information
   - Evaluating contaminant concentrations and toxicities
   - Examining contaminant mobility, persistence, and bioaccumulation
   - Identifying release mechanisms
   - Identifying special exposure routes
   - Evaluating contaminant treatability (retain those more difficult to treat than others)
   - Assessing availability of contaminant ARARs
   - Grouping chemicals by class according to structure-activity relationships or other similarities
   - Evaluating frequency of detection
   - Estimating intake

- Identifying essential nutrients
- Using a concentration-toxicity screen to identify those contaminants that are expected to contribute the most to overall risks.

To judge the degree and extent of risk to public health and the environment (including plants, animals, and ecosystems), the projected concentrations of COCs at exposure points will be compared with ARARs, as stated in Section 3.0. Because ARARs do not exist for certain media (such as soils), nor are all ARARs necessarily health based, this comparison is not sufficient in itself to satisfy the requirements of the risk assessment process. Moreover, receptors may be exposed to contaminants in more than one medium so that their total doses might exceed risk reference doses (RfDs) and/or might result in an excess cancer risk greater than an acceptable target risk, as defined by EPA (e.g., 10^{-6} to 10^{-4}). Nevertheless, the comparison with standards and criteria is useful in defining the exceedence of institutional requirements. Aside from the ARARs discussed in Section 3.0, the following criteria will be examined:

- Drinking-water health advisories
- Ambient water quality criteria for protection of human health
- Center for Disease Control and Agency for Toxic Substances and Disease Registry soil advisories
- National Ambient Air Quality Standards

Potential COCs will be evaluated in terms of all considerations in an iterative process. Thus, a chemical may be eliminated as a COC on the basis of one criterion, but it may subsequently be identified as a COC on the basis of another criterion (and vice-versa). Adequate documentation will be prepared to justify including or excluding specific contaminants.

8.2.4 Uncertainty in Data Collection Evaluation

The assessment of the data collection process listed above involves the evaluation of five indicators: completeness, comparability, representativeness, precision, and accuracy. Uncertainty within each of these parameters will influence the selection of COCs, affect the estimates of average and maximum concentration of the chemical, and ultimately influence the risk characterization results. A qualitative identification of the key site variables such as sampling location, sampling frequency, use of historical data, and selection of COCs will be performed for this Data Collection/Evaluation Section.

8.3 EXPOSURE ASSESSMENT

The exposure assessment objective is to determine how exposures to site contaminants could occur, and to estimate the extent of exposure if it occurs. The exposure assessment includes several tasks:

- Characterize the exposure setting relative to contaminant fate and transport and potentially exposed populations

- Identify exposure pathways based on chemical source and release, exposure point, and exposure route

- Identify uncertainties associated with the exposure assessment that impact the risk characterization

Exposure is defined as the contact of an organism with a contaminant or physical agent. The magnitude of exposure is determined by measuring or estimating the amount of a contaminant available at the exchange boundaries (i.e., lungs, intestines, and skin). When contaminants migrate from the site to an exposure point (a location where receptors can come into contact with contaminants), or when a receptor directly contacts the contaminated media, exposure can occur. The radionuclides present at this OU do produce an external exposure hazard, albeit a minor one. Nevertheless, this external exposure route will be assessed and used in the risk characterization.

8.3.1 Conceptual Site Model

The site conceptual model for OU15 (Figures 2-6 and 2-7) will be used to evaluate primary and secondary contaminant sources and releases, and potential receptors and associated exposures. The model helps to characterize the exposure setting relative to contaminant fate and transport mechanisms through exposed receptors. The conceptual site model for OU15 may be revised on RFI/RI data collected for the OU15 to incorporate new information. Although not explicitly described by the OU15 conceptual site model, residential and occupational exposure pathways through ingestion, inhalation, or dermal contact with site-related contaminants will be considered for evaluation in the risk characterization if the revised conceptual model suggests they may be complete exposure pathways. A completed exposure pathway consists of all five of the elements listed below:

1. Source of contaminant
2. Mechanism of chemical release to the environment
3. Environmental transport medium (e.g., air, ground water) for the released constituent
4. Point of potential contact of human or biota with the affected medium (the exposure point)
5. Exposure route (e.g., inhalation of contaminated dust) at the exposure point

If any of these five elements is missing from a potential pathway, exposure cannot occur and thus the pathway can be eliminated from the risk assessment process. The conceptual model contains all potential exposure pathways, and part of the goal of the RFI/RI Work Plan is to determine if a completed exposure pathway exists.

8.3.2 Contaminant Fate and Transport

The conceptual site model helps identify potential contaminant fate and transport mechanisms. These could include soil contaminants leaching to ground water, soil entrainment and downwind deposition, or surface runoff that transports surface soil downslope. Contaminant-specific characteristics affect fate and transport. Chemical-specific factors affecting the probability a contaminant will migrate include, but are not limited to:

- Solubility
- Partition coefficient
- Vapor pressure
- Henry's Law constant
- Bioconcentration factor

The evaluation of these chemical-specific factors will help determine if contaminants can migrate from their sources to potential receptors, not only those identified under current use scenarios but those identified under potential future exposure scenarios as well.

8.3.3 Exposure Pathways

By using the conceptual site model and information on contaminant fate and transport, exposure pathways can be identified. The Human Health Risk Assessment will consider only complete exposure pathways (or pathways that could be complete under potential future situations), those for which data support the presence of a source, release mechanism, transport mechanism, exposure route, and affected receptor. Complete exposure pathways include the receptors and exposure route (ingestion, inhalation, and dermal).

8.3.4 Potential Receptors

The exposure scenarios that will be developed in the Human Health Risk Assessment may include exposure of onsite workers, exposure of potential future receptors to contaminated media within OU15, and exposure of offsite receptors to potentially contaminated ground water, surface water, and airborne soil particulates. The exact exposure scenarios to be considered will be selected according to an assessment of future use (e.g., residential, recreational, restricted access) of the site that may be made prior to completion of the Human Health Risk Assessment.

8.3.5 Exposure Point Concentrations

By using the data set identified as part of Section 8.2.2, and the results of contaminant fate and transport modeling, exposure point concentrations of COCs will be estimated on the basis of analytical results of the sampling program described in Section 7.0 and available relevant historical data. Some data will be collected at the point of exposure. Other data collected at the source may be used in conjunction with a transport model to estimate expected concentration at some exposure point. Because modeling may add uncertainty, the Work Plan emphasizes collecting data at exposure points where possible (even though these data provide only a snapshot of conditions in time and space).

Release and transport of contaminants in environmental media may be modeled using analytical and/or numerical models recommended and approved by EPA (e.g., AIRDOS) or the best model available, as determined by a model performance evaluation. The models will be calibrated to improve performance using site-specific parameters. The selection of appropriate model(s) will be documented in the Baseline Risk Assessment Plan (BRAP) technical memorandum required under VII.D.1.b of the IAG Statement of Work (U.S. DOE, 1991a).

Model outputs will be characterized by estimating variance through an uncertainty analysis to the extent required by the overall risk uncertainty analysis. Reasonable efforts will be made to minimize the variance of model output. Other major contributors to the overall risk assessment uncertainty include exposure factors used in the estimation of intake and the toxicity parameters (reference dose and cancer slope factors) used to evaluate the effect of an acquired dose.

Exposure point concentrations will be expressed as reasonable maximum exposure (RME) concentrations and average concentrations. RME concentrations are represented by the 95th percent confidence limit on the average or the maximum-reported concentration, whichever is lower. Depending on the quantity of data and their appropriateness for grouping, data distribution will be used to determine the appropriateness of using geometric or arithmetic means to estimate the RME concentrations.

When feasible, a goodness-of-fit analysis will be conducted to correctly identify the distribution of the data and the most appropriate measure of central tendency. The reasonable maximum concentration will be the upper 95th percent confidence limit on the appropriate mean or maximum likelihood estimate. In calculating the media concentrations, censored data (data sets with missing values, non-detects, etc.) will be treated by appropriate methods such as those described in *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987).

8.3.6 Contaminant Intake Estimation

In general, chemical intakes will be estimated using available, region-specific exposure parameters. Deviation from standard parameters will be documented and submitted to the regional EPA office for approval prior to preparation of the risk assessment.

Contaminant exposure (or intake) is normalized for time and body weight and is expressed as milligrams of contaminant per kilogram of body weight per day (mg/kg/day). Radionuclide intake is based on total activity and is expressed as picoCuries of radionuclide (pCi). Six basic factors are used to estimate intake: exposure frequency, exposure duration, contact rate, chemical concentrations, body weight, and averaging time. These factors are based on the types of exposure (e.g., residential or occupational, ingestion, or inhalation).

The RME and average exposure point concentrations are used in conjunction with receptor activity patterns to estimate contaminant intake for each exposure route as appropriate. EPA requires using 95th percentile rates, 90th or 95th percentile values for exposure duration, and average values for parameters such as body weight. For example, a residential land use scenario describes an adult, weighing 70 kg, who works at home and consumes 2 liters of water and breathes 20 cubic meters (m^3) of air per day. The individual stays at home 350 days per year and lives in the same residence for 30 years. Different parameters are used for children, adult workers, and recreational exposures based on information provided by EPA in the *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual Supplemental Guidance*, "Standard Default Exposure Factors," Interim Final, March 25, 1991 (U.S. EPA, 1989c). Also, the averaging time for carcinogens and non-carcinogens differ.

Other standard intake rates established by EPA that will be used, if appropriate, include the following:

- Soil ingestion rates for children ages 1 through 6
- Soil ingestion rates for all others (workers and residents more than 6 years of age)
- Inhalation rates based on activity levels

Contaminant rates can also be estimated for dermal exposures. Of the three routes of exposure (ingestion, inhalation, and dermal), the greatest uncertainty is associated with dermal exposures. Part of this uncertainty results from the lack of chemical-specific permeability constants. The Human Health Risk Assessment will calculate the estimated contaminant intake through dermal exposures and compare the intake values to those calculated for ingestion as the basis for demonstrating the significance of the dermal route relative to other routes of exposure.

Human intake of COCs will be estimated using reasonable estimates of exposure parameters. EPA guidance, site-specific factors, and professional judgement will be applied in establishing exposure assumptions. Using reasonable values allows estimation of risks associated with the assumed exposure conditions without underestimating actual risk.

Depending on the data collected and the refinement of the conceptual site model, nontraditional exposure routes that may be included in the Human Health Risk Assessment, include fish ingestion and exposures resulting from recreational uses of the reservoirs (contact with sediments, ingestion, and dermal contact with surface water) and the nearby open spaces (hiking, bicycling).

Other nontraditional exposure routes may be identified by using land use data for the OU15 area. These include exposure scenarios related to agricultural land uses and other recreational land uses within the OU15 area.

8.3.7 Uncertainty in the Exposure Assessment

The ability to construct exposure scenarios for a site depends on the amounts and kinds of environmental data collected for that purpose. Some uncertainty is inherent in environmental data collection. The numbers and kinds of uncertainties included in the exposure assessment directly impact the risk characterization; many professional judgements impact the identification and description of physical site attributes that affect exposure and activity patterns. One of the major areas of uncertainty in the exposure assessment is the prediction of human activities that lead to contact with environmental media and exposures to site-related contaminants. This section of the Human Health Risk Assessment will identify and describe how site attributes related to environmental sampling and analysis, fate and transport modeling, and exposure parameter estimation and assumptions about them affect uncertainty relative to assessing risk. The exposure assessment uncertainty analysis will discuss the potential magnitude of over- or under-estimation, or both, provides an indication of the impact, by orders of magnitude, the uncertainty imparts on the estimation of risk.

The uncertainty analysis will identify and evaluate non-site-specific and site-specific factors that may produce uncertainty in the risk assessment, such as assumptions inherent to development of toxicological endpoints (potency factors, reference doses) and assumptions considered in the exposure assessment (model input variability, population dynamics). Statistical simulation techniques (such as Monte-Carlo) may be employed for contaminants for which quantitative evaluation is possible. The goal of this task will be to quantify, to the extent practicable, the uncertainty propagated through the risk assessment process. The uncertainty analysis will present the spectrum of potential risks under specified scenarios such that the risk management decision maker can obtain an understanding of the level of confidence associated with all estimates of potential human health risk.

8.4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to describe the contaminants considered in the Human Health Risk Assessment relative to their potential to cause harm. The toxicity assessment has two general steps. The first determines what adverse health impacts, if any, could result from exposure to a particular contaminant. These are typically classified as carcinogenic and non-carcinogenic health effects. The second step, dose-response evaluation, quantitatively examines the relationship between the level of exposure and the incidence of adverse health effects.

Toxicity depends on the dose or concentration of the substance (dose-response relationship). Toxicity values are a quantitative expression of the does-response relationship for a contaminant and take the form of RfDs and cancer slope factors, both of which are specific to exposure via different routes.

Two sources of toxicity values are currently available for chemicals and radionuclides. The primary source is the EPA's Integrated Risk Information System (IRIS) data base. (U.S. EPA, 1987b). IRIS contains up-to-date health risk and regulatory information. IRIS contains only those RfDs and slope factors that have been verified by the EPA work groups and is considered by EPA to be the preferred source of toxicity information for chemicals.

Following IRIS, the most recently available Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1990b), issued by the EPA's Office of Research and Development, will be consulted to identify interim RfDs and slope factors for radionuclides.

In addition to identifying appropriate toxicity values, this section of the Human Health Risk Assessment will provide brief toxicity profiles based on recent, published literature for each contaminant evaluated in the Human Health Risk Assessment. These profiles will describe the acute, chronic, and carcinogenic health effects associated with site-related contaminants identified in OU15. Acute and chronic exposure to site-related radionuclides will be discussed, but most of the information presented will deal with the carcinogenic hazard posed by the site-specific radionuclides.

8.4.1 Uncertainty In Toxicity Assessment

A summary of the uncertainty inherent in the toxicity values for the COCs shall be compiled and included in the Human Health Risk Assessment. This summary shall include the following information:

- Qualitative hazard findings
  - potential for human toxicity

- Derivation of toxicity values
  - human or animal data
  - duration of study

- Potential for synergistic or antagonistic interaction with other substances

- Calculation of lifetime cancer risks on the basis of less than lifetime exposures

8.5 RISK CHARACTERIZATION

This section of the Human Health Risk Assessment presents the evaluation of potential risks to public health associated with exposure to contaminants at the OU15 site. Potential carcinogenic and non-carcinogenic risks associated with complete exposure pathways will be estimated. Risk characterization involves integrating exposure assumptions and toxicity information to quantitatively estimate the risk of adverse health effects. Risk characterization will be performed in accordance with EPA guidance (U.S. EPA, 1989c).

Non-cancer risk will be assessed by comparing the estimated daily intake of a contaminant to its RfD. This comparison measures the potential for non-carcinogenic health effects given the chemical intake factors used to estimate exposure. To assess the potential for non-cancer effects posed by multiple chemicals, EPA's hazard index approach will be used. This method assumes dose additivity. Hazard quotients (individual chemical intake divided by the chemical RfD) are summed to provide a hazard index, and if the index exceeds one, a potential for health risk is suggested. If a hazard index exceeds one, where possible, chemicals may be segregated by similar effect or target organ to determine the potential health risks. Separate hazard indexes may be derived for each effect if sufficient information or target organ specificity is available.

The potential for carcinogenic effects will be estimated by calculating excess lifetime cancer risks from the lifetime average exposure and cancer slope factor. These will be upper-bound estimates because methods used to estimate slope factors are regarded as upper bounds on potential cancer risks rather than accurate representations of true cancer risk.

Both non-cancer and cancer risks will be estimated by using RME and average contaminant intake values combined with exposure assumptions. This allows risk ranges to be considered rather than a single value and more closely considers the uncertainty associated with the estimates. In addition, risks may be added across exposure routes to assess the potential for additive affects.

Not all contaminants identified at OU15 will have toxicity values, thereby limiting the ability to develop quantitative estimates of risk. Where adequate toxicity values cannot be identified, potential risks associated with exposure to those constituents will be dealt with qualitatively.

8.5.1 Uncertainties in the Risk Characterization

The numbers and kinds of uncertainties identified in the Human Health Risk Assessment directly impact the interpretation of estimated risks developed in this section. Quantitative risk estimates derived in risk assessments are conditional estimates that include numerous assumptions about exposures and toxicity. Uncertainty is introduced from a variety of sources, including, but not limited, to the following sources:

- Sampling and analysis
- Exposure estimation
- Toxicological data.

As stated in the EPA risk assessment guidance document (U.S. EPA, 1989c), a highly quantitative statistical uncertainty analysis is usually not practical or necessary for site risk assessments. As in all environmental risk assessments, it is already known that the uncertainty about the numerical results is large. Consequently, it is more important to identify the key site related variables and assumptions that contribute most to the uncertainty than to precisely quantify the degree of uncertainty in the risk assessment.

At a minimum, uncertainty will be described qualitatively in terms of under-or over-estimation of risk, or both. If possible, uncertainty may be described quantitatively using sensitivity analyses or other numerical models.

Table 8-1: EPA Guidance Documents That May Be Used in the Risk Assessment Task

- EPA's Integrated Risk Information System (IRIS) -- Office of Research and Development (continuously updated). Agency's primary source of chemical-specific toxicity and risk assessment information. Includes narrative discussion of toxicity data base quality and explains derivation of Reference Doses, cancer potency factors, and other key dose response parameters. IRIS presents information that updates data originally presented in Exhibits A-4 and A-6 of the SPHEM (see below). Further information: IRIS Users Support, 513-569-7254 (U.S. EPA, 1987b).

- Health Effects Assessment Summary Tables (HEAST) -- Office of Research and Development/Office of Emergency and Remedial Response (updated quarterly). Because the IRIS chemical universe (while growing) is currently incomplete, the HEAST has been produced to serve as a "pointer" system to identify current literature and toxicity information on important non-IRIS chemicals. While HEAST data in some cases may be "Agency-verified", the information is considered valuable for Superfund risk assessment purposes. Available from Superfund docket, 202-382-3046 (U.S. EPA, updated quarterly).

- Risk Assessment Guidance for Superfund, Human Health Evaluation Manual Part A, Interim Final -- Office of Emergency and Remedial Response. This volume provides updated risk assessment procedures and policies, specific equations and variable values for estimating exposure, and a hierarchy of toxicity data sources. There is an expanded chapter on risk characterization to help summarize information for the decision makers and detailed descriptions of uncertainties in risk assessment (U.S. EPA, 1989b).

- OSWER Directive on Soil Ingestion Rates -- Office of Solid Waste and Emergency Response (January 1989), OSWER Directive #9850.4. Recommends soil investigation rates for use in risk assessment when site-specific information is not available. Available from Darlene Williams, 202-475-9810 (U.S. EPA, 1989b).

- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference -- Office of Solid Waste and Emergency Response EPA 600-3/89/013. This report is a field and laboratory reference document that provide guidance on designing, implementing, and interpreting ecological assessments of hazardous waste sites. It includes sections on ecological endpoints, field sampling design, quality assurance, aquatic and terrestrial toxicity and field survey methods, recommended biomarkers, and data analysis (U.S. EPA, 1989d).

- Risk Assessment Guidance for Superfund -- Environmental Evaluation Manual, Interim Final (RAGS-EEM) -- Office of Emergency and Remedial Response (March 1989), EPA/540/1-89/001A. Provides program guidance to help remedial project managers and on-scene coordinators manage ecological assessment at Superfund sites (U.S. EPA, 1989b).

- Exposure Factors Handbook -- Office of Research and Development (March 1989), EPA/600/8-89/043. Provides statistical data on the various factors used in assessing exposure; recommends specific default values to be used when site-specific data are not available for certain exposure scenarios. Further information: Exposure Methods Branch, 202-382-5988 (U.S. EPA, 1989e).

- Superfund Public Health Evaluation Manual (SPHEM) -- Office of Emergency and Remedial Response. The current program risk assessment guidance manual. Explains how to conduct a baseline site risk assessment, set preliminary goals, and evaluate risks of remedial alternatives. (U.S. EPA, 1988e).

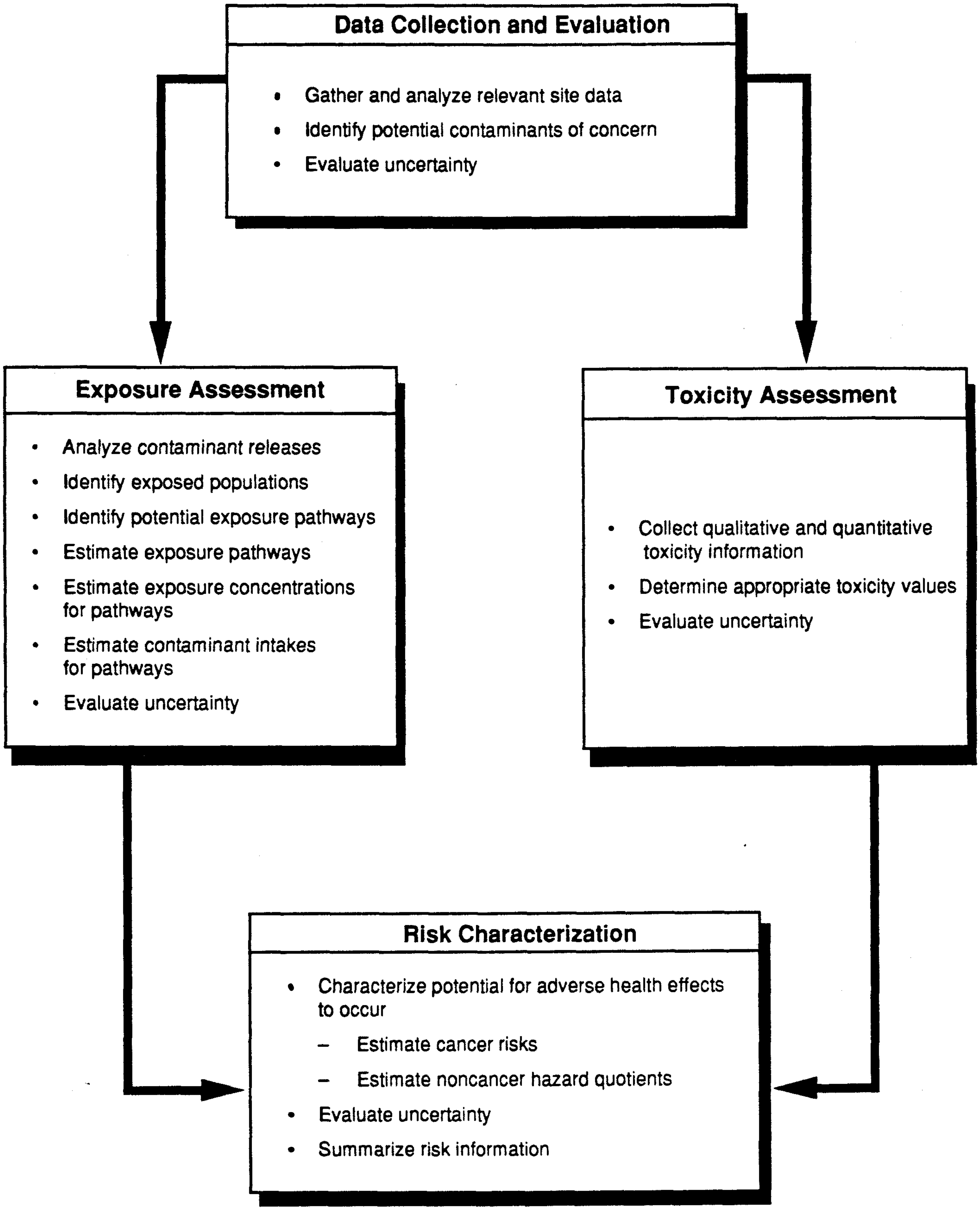
- Superfund Risk Assessment Information Directory (RAID) -- Office of Emergency and Remedial Response (November 1986), EPA/540/1-86/061. Describes sources of information useful in conducting risk assessments. Currently under revision.*

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA -- Office of Emergency and Remedial Response EPA/540/g-89/004. This guidance document is a revision of the U.S. EPA's 1985 guidance. It describes general procedures for conducting an RI/FS (U.S. EPA, 1988a).

- Superfund Exposure Assessment Manual (SEAM) -- Office of Emergency and Remedial Response (April 1988), EPA/540/1-88/001. Provides a framework for the assessment of exposure to contaminants at or migrating from hazardous waste sites. Discusses modeling and monitoring* (U.S. EPA, 1988d).

- CERCLA Compliance With Other Laws Manual -- Office of Emergency and Remedial Response. The guidance is intended to assist in the selection of onsite remedial actions that meet the applicable or relevant and appropriate requirements (ARARs) of the Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), and other federal and state environmental laws as required by CERCLA, Section 121 (U.S. EPA, 1988e).

- Guidance for Data Useability in Risk Assessment -- Interim Final 1990a. EPA/540/G-90/008.



Human Health Risk Assessment

Figure 8-1

Approved by:

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Manager, Remediation Programs RFI Project Manager

9.0 ENVIRONMENTAL EVALUATION

OU15 lies entirely within the production area at the RFP site in areas 400 and 800. All of the six IHSSs included in OU15 are located inside buildings. Sufficient ecosystems, components, or functions do not exist within the boundaries of OU15 to justify a comprehensive ecological risk assessment. In addition, the area containing OU15 IHSSs overlaps with other plant site OUs and is completely contained within the OU9 preliminary study area. OU9 is the Original Process Waste Lines, a network that extends throughout much of the production area. The OU9 EE Work Plan defines an ecological risk assessment within the production study area that is reduced in scope and focused on requirements proportional to the depauperate ecosystems found there. The objective of the OU15 EE is to determine whether there is a risk of contamination of offsite biota by target taxa migrating from the study area. This objective will be completed in the assessment of OU9. OU15 EE requirements will be met when the OU9 EE is completed because of their overlapping study areas. Habitat and biological surveys proposed for OU9 will cover the entire industrial area including OU15. Biota and habitat surveys proposed for OU9 will be adequate for the biological and habitat characterization of areas potentially affected by OU15 and will not be duplicated or repeated. Therefore, no additional ecological data will be collected in conjunction with the Phase I RFI/RI for OU15.

Ecotoxicological investigations will not be conducted for OU15 unless there exists a viable pathway for transport of contaminants outside of the IHSSs within OU15. If not, then it is presumed that there is no risk of contamination of offsite biota from OU15. If an ecotoxicological investigation is necessary, it would consist of procedures presently under development for OU9.

Information obtained during an ecotoxicological investigation would be used to assess the ecological risk posed by contaminant migration by biological pathways. Information on contaminant migration by target taxa to other OUs will be provided to those OU managers for use in conducting their EEs for identifying ecological risks. This would be a quantitative estimate with the appropriate uncertainty analysis for model assumptions and estimates of parameters. This information would also be coordinated with contaminant migration by physical or abiotic media developed during the site characterization and transport models.

Approved by:

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Manager, Remediation Programs   RFI Project Manager

10.0 QUALITY ASSURANCE ADDENDUM

This section consists of the Quality Assurance Addendum (QAA) for Phase I investigations at Operable Unit No. 15 (OU15), which supplements the "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP). This QAA establishes the site-specific Quality Assurance (QA) controls applicable to the investigation activities described previously in the OU15 Work Plan (OU15 WP).

OU15 is one of 16 operable units (OUs) identified for investigations under the Rocky Flats Plant (RFP) Interagency Agreement (IAG). OU15 contains 6 individual hazardous substance sites (IHSSs). All 6 IHSSs are RCRA-regulated interim status closure units located inside of buildings. The IHSSs were described previously in Section 2.2. Section 2.4 described the nature and extent of contamination at the IHSSs. This OU15 WP has been prepared in accordance with EPA/530/SW-89-031, "RCRA Facility Investigation (RFI) Guidance" (May 1989), EPA/540/8-89/004, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (October 1988), and the IAG.

10.1 ORGANIZATION AND RESPONSIBILITIES

The overall organization of EG&G Rocky Flats and the Environmental Management Department (EMD) and divisions involved in Environmental Restoration (ER) Program activities is shown in Figures 1-1, 1-2, and 1-3 of Section 1.0 of the QAPjP. Individual responsibilities are also described in Section 1.0 of the (QAPjP).

Subcontractors will be tasked by EG&G Rocky Flats to implement the sampling and analysis activities outlined in the OU15 WP. The specific EMD personnel who will interface with the subcontractors and who will provide technical direction are shown in Figure 10-1.

10.2 QUALITY ASSURANCE PROGRAM

The QAPjP was written to address QA controls and requirements for implementing IAG-related activities. The content of the QAPjP was driven by Department of Energy (DOE) RFP Standard Operating Procedure (SOP) 5700.6B and the IAG. SOP 5700.6B requires a QA program to be implemented for all RFP activities based on American Society of Mechanical Engineers (ASME) NQA-1, "Quality Assurance Requirements for Nuclear Facilities." The IAG specifies development of a QAPjP in accordance with EPA/QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." The 18-element format of NQA-1 was selected as the basis for both the QAPjP and subsequent QAAs with the applicable elements of QAMS-005/80 incorporated where appropriate. Figure 2-1 of the QAPjP illustrates where the 16 QA elements of QAMS-005/80 are integrated into the QAPjP and also into this QAA. Section 2.0 of the QAPjP also identifies other DOE Orders and QA requirements documents to which the QAPjP and this QAA are responsive.

The controls and requirements addressed in the QAPjP are applicable to OU15 Phase I activities, unless specified otherwise in this QAA. Where site-wide actions are applicable to OU15 activities, the applicable section of the QAPjP is referenced in this QAA. This QAA addresses additional and site-specific QA controls and requirements that are applicable to OU15 Phase I RFI/RI activities that may not have been addressed on a site-wide basis in the QAPjP. Many of the QA requirements specific to OU15 are addressed within other sections of this work plan and are referenced in this QAA.

10.2.1 Training

Personnel qualification and training requirements for RFP ER Program activities are addressed in Section 2.0 of the QAPjP. All EG&G and subcontractor staff working on OU15 Phase I investigations shall be trained in the EMD Operating or laboratory analytical procedures that are applicable to their assigned tasks. Subcontractor Project Managers shall be trained by the EMD and shall be responsible for training subcontractor staff according to EMD Administrative Procedure 3-21000-ADM-02.01, Personnel Training, using EG&G-furnished lesson plans. All personnel training shall be documented according to 3-21000-ADM-02.01.

EG&G EMD and subcontractor personnel shall also meet the minimum qualification and training requirements specified in the EMD Operating Procedures (OPS) and Environmental Management Radiological Guidelines (EMRGs). The EMD OPS (which may have been referred to as Standard Operating Procedures [SOPs] in the QAPjP and other sections of this OU15 WP) and EMRGs that are applicable to OU15 Phase I activities are identified in Table 10.1.

10.2.2 Quality Assurance Reports to Management

A QA summary report will be prepared annually or at the conclusion of these activities (whichever is more frequent) by the EMD Quality Assurance Project Manager (QAPM) or designee. This report will include a summary of field operation and laboratory inspections, surveillance, and audits and a report on data verification/validation results.

10.3 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

10.3.1 Design Control

The OU15 WP describes the investigation activities that will be implemented during Phase I. The work plan identifies the objectives of the investigations; specifies the sampling, analysis, and data generation requirements; and identifies applicable operating procedures that will provide controls for the investigations. As such, the OU15 WP is considered the investigation control plan for the OU15 Phase I RFI/RI activities.

10.3.2 Data Quality Objectives

The development of Data Quality Objectives (DQOs) for the OU15 Phase I investigations was presented in Section 4.0. The DQOs for OU15 were established in accordance with 3-stage process described in EPA/540/G-87/003 (OSWER Directive 9355.0-7B), Data Quality Objectives for Remedial Response Activities, and Appendix A of the QAPjP.

Identification of data quality needs includes defining specific investigation objectives, identifying data uses, and selecting the types of samples and data that need to be collected. Specific Phase 1 investigation objectives, data uses, sample types, data types, and data quality objectives (DQOs) for OU15 were defined in Section 4. Other factors that are necessary in identifying data quality needs include selecting appropriate analytical levels, contaminants of concern, levels of concern, and required detection limits. The identification and selection of these factors were also established in Section 4 and summarized in Tables 4-1 and 4-2.

Data quality is typically measured in terms of precision, accuracy, representativeness, comparability, and completeness (also referred to as PARCC parameters). Precision, accuracy, and completeness are quantitative measures of data quality, while representativeness and comparability are qualitative statements that express the degree to which sample data represent actual conditions and describe the confidence of one data set to another. These parameters are defined in Appendix A of the QAPjP. PARCC parameters will be determined for OU15 Phase I measurement data, as described in Appendix A of the QAPjP. PARCC parameter objectives, that are established prior to initiating investigations, assist decision makers in determining if DQOs for measurement data have been met.

The specific objectives for precision and accuracy for TCL volatile organics and TAL metals that will be analyzed according to EPA CLP analytical requirements are presented in Appendix B of the QAPjP. These objectives are applicable to the analysis of volatiles and metals for OU15 samples. Appendix B of the QAPjP also identified precision and accuracy objectives for radionuclides that will be analyzed according to methods specified in Part B of the GRRASP. These objectives are applicable to the analysis of radionuclides for OU15 samples. Precision and accuracy objectives for the radiological screening data are not specified. Precision and accuracy for radiological survey data will be controlled by adhering to radiological surveying procedures, including meeting the instrument detection, efficiency, and calibration requirements specified in the procedures and manufacturers instructions. The goal for completeness is 100 percent with a minimum acceptable completeness of 90 percent for laboratory measurement data.

Based on the data quality needs identified for OU15 Phase I investigations, the sampling and analytical options were evaluated. The sampling and analytical methods selected for OU15 Phase I investigations are listed in Table 4-1.

10.3.3 Sampling Locations and Sampling Procedures

The sampling plan for OU15 was described in Sections 7.3 and summarized in Table 7-2. Sampling activities within the buildings that comprise OU15 are generally non-intrusive. Sampling will consist of reviewing any new data and information, conducting visual inspections, performing surface radiological surveys, drum and polyethylene bottle contents (if present), surface wipe sampling, and soot sampling (where present).

The operating procedures that are applicable to OU15 sampling were listed in Table 10.1.

10.3.4 Analytical Procedures

The analytical requirements for the OU15 were discussed in Section 7.4.2. The analytical methods that shall be adhered to are those that are specified in the EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B. These methods are referenced in Section 3.0 of the QAPjP.

10.3.5 Equipment Decontamination

Non-dedicated sampling equipment (i.e., sampling equipment that is used at more than one location) shall be decontaminated between sampling locations in accordance with OPS-FO.03, General Equipment Decontamination.

10.3.6 Air Quality

Air monitoring for suspended particulates will not be required, as none of the sampling activities proposed have the potential for producing suspended particulates.

10.3.7 Quality Control

To ensure the quality of the field sampling techniques, collection and/or preparation of field quality control (QC) samples are incorporated into the sampling scheme. Field QC samples and collection frequencies for OU15 were addressed in Section 7.6 and identified in Table 7-5. A specific sampling schedule will be prepared by the sampling subcontractor for approval by the EG&G Laboratory Analysis Task Leader (Figure 10.1) prior to sampling.

10.3.7.1 Objectives for Field QC Samples:

Equipment rinsate blanks are considered acceptable (with no need for data qualification) if the concentration of analytes of interest is less than three times the required detection limit for each analyte as specified in Table 7-1. Equipment rinsate blanks may only be analyzed if contaminants of concern are detected above background in samples. Field duplicate samples shall agree within 30 percent relative percent difference for aqueous samples and 40 percent for homogenous, non-aqueous samples.

Trip blanks and field preservation blanks (for organics and inorganics, respectively) indicate possible field contamination when analytes are detected above the minimum detection limits presented in Table 7-1. The Laboratory Analysis Task Leader is responsible for verifying these criteria and is also responsible for checking to see if they are met and for qualifying measurement data.

10.3.7.2 Laboratory QC

Laboratory QC procedures are used to provide measures of internal consistency for analyses and storage of samples. The laboratory contractor will submit written SOPs to the Laboratory Analysis Task Leader for approval. The inter-laboratory SOPs shall be consistent with or equivalent to EPA-CLP QC procedures. The laboratory SOPs must cover the following areas in sufficient detail and reflect actual operating conditions in effect during analysis of EG&G RFP samples:

- Sample receipt and log-in
- Sample storage and security
- Facility security
- Sample tracking (from receipt to sample disposition)
- Sample analysis method references
- Data reduction, verification, and reporting
- Document control (including submitting documents to EG&G)
- Data package assembly (see Section III.A of the GRRASP)
- Qualifications of personnel
- Preparation of standards
- Equipment maintenance and calibration
- List of instrumentation and equipment (including date purchased, date installed, model number, manufacturer, and service contracts, if any)
- Instrument detection limits
- Acceptance criteria for non-CLP analyses
- Laboratory QC checks applicable to each analytical method

Laboratory QC techniques to ensure consistency and validity of analytical results (including detecting potential laboratory contamination of samples) include using reagent blanks, field blanks, internal standard reference materials, laboratory replicate analysis, and field duplicates. The laboratory contractor will follow the standard evaluation guidelines and QC procedures, including frequency of QC checks, that are applicable to the particular type of analytical method being used as specified in Parts A and B of the GRRASP and Section 3.0 of the QAPjP. All data packages will be forwarded to the Laboratory Analysis Task Leader or validation contractor for review and verification.

10.3.8 Quality Assurance Monitoring

To assure the overall quality of the RFI/RI activities discussed in the OU15 WP, field inspections will be conducted daily and audits and surveillance will be conducted at various intervals. The intervals will be determined by the importance and complexity of each activity. Audit and surveillance intervals will be based on the schedule contained in Section 5.0. At a minimum, each of the field sampling activities described in Sections 7.3 and the visual inspections will be monitored by independent oversight inspectors at least once during the sampling process. EG&G will conduct audits of the laboratory contractor(s) as specified in the GRRASP, Parts A and B. The audits and surveillance, and activity Readiness Reviews are discussed further in Section 10.18.

10.3.9 Data Reduction, Validation, and Reporting

10.3.9.1 Analytical Reporting Turnaround Times

Analytical reporting turnaround times are as specified in Table 3-1 of Section 3.0 of the QAPjP.

10.3.9.2 Data Reduction

Reduction of laboratory measurements shall be in accordance with the methods specified for each analytical method. Laboratory data will be compiled into sample data packages by the laboratory contractor. A sample data package shall be developed for each sample delivery group or sample batch, with separate data packages for each type of analysis (e.g., a data package for organics, one for inorganics, one for water quality parameters, and one for radionuclides). The sample data package shall consist of a cover sheet/transmittal letter, a case narrative, data summary forms, and copies of the data checklists found in Attachments I in Parts A and B of the GRRASP. The reduced data will be used in the data validation process to verify that the laboratory control and the overall system DQOs have been met.

10.3.9.3 Data Validation

Validation activities consist of reviewing and verifying field and laboratory data and evaluating these verified data for data quality (i.e., comparison of reduced data to DQOs, where appropriate). The field and laboratory data validation activities and guidelines are described and referenced in Section 3.0 of the QAPjP. The process for validating the quality of the data is illustrated graphically in Figure 3-1 of Section 3.0 of the QAPjP, and is also included as part of the sample collection, chain-of-custody, and analysis process illustrated in Figure 8-1 of Section 8.0 of the QAPjP. The criteria for determining the validity of ER data at Rocky Flats are described in subsection 3.3.7 of Section 3.0 of the QAPjP.

10.3.9.4 Data Reporting

Depending on the data validation process, data are flagged as either "valid," "acceptable with qualifications," or "rejected." The results of the data validation shall be reported in ER Department Data Assessment Summary reports. The usability of data (the criteria of which is also described in subsection 3.3.7 of Section 3.0 of the QAPjP) shall also be addressed by the RFI Project Manager.

10.4 PROCUREMENT DOCUMENT CONTROL

Procurement documents for items and services, including services for conducting field investigations and analytical laboratories, shall be prepared, handled, and controlled in accordance with the requirements and methods specified in Section 4.0 of the QAPjP.

10.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The OU15 WP describes the activities to be performed. The OU15 WP will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in Section 5.0 of the QAPjP.

EMD OPS that have been, or will be, approved for use are identified in Table 10.1, which also indicates their applicability. Any additional quality-affecting procedures proposed for use but not identified in Table 10.1 will be developed and approved as required by Section 5.0 of the QAPjP prior to performing the affected activity.

Changes and variances to approved operating procedures shall be documented through preparation of Document Change Notices (DCNs), which will be prepared, reviewed, and approved in accordance with requirements specified in Section 5.0 of the QAPjP. (Note: DCNs were referred to as Procedure Change Notices in Revision 0 of the QAPjP). Any changes, revisions, additions, or deletions to the OU15 WP will be presented in either DCNs or Technical Memoranda. DCNs and Technical Memoranda will be reviewed and approved by the same organizations that reviewed and approved the original OU15 WP.

10.6 DOCUMENT CONTROL

The following documents will be controlled in accordance with Section 6.0 of the QAPjP:

- "Phase I RFI/RI Work Plan for Inside Building Closures, Operable Unit No. 15"
- "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP)
- EMD Operating Procedures and EM Radiological Guidelines (all existing and proposed operating procedures specified in this QAA, and to-be-developed laboratory SOPs).

10.7 CONTROL OF PURCHASED ITEMS AND SERVICES

Contractors that provide services to support the OU15 Phase I RFI/RI activities will be selected and evaluated as outlined in Section 7.0 of the QAPjP. This includes pre-award evaluation/audit of proposed contractors as well as periodic audit of the acceptability of contractor performance during the life of the contract. Any items or materials that are purchased for use for investigations at OU15 that have the ability to affect the quality of the data shall be inspected upon receipt.

10.8 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

10.8.1 Sample Containers/Preservation

Appropriate volumes, containers, preservation requirements, and holding times for liquid and solid samples were presented in Tables 7-3 and 7-4.

10.8.2 Sample Identification

RFI/RI samples shall be labeled and identified in accordance with Section 8.0 of the QAPjP and OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Samples shall have unique identification that traces the sample to the source(s) and indicates the method(s), date, the sampler(s), and conditions prevailing at the time of sampling.

10.8.3 Chain-of-Custody

Sample chain-of-custody will be maintained through the application of OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples, and as illustrated in Figure 8-1 of the QAPjP for all environmental samples collected during field investigations.

10.9 CONTROL OF PROCESSES

The overall process of collecting samples, performing analysis, and inputting the data into a database is considered a process that requires control. The process is controlled through a series of written procedures that govern and document the work activities. A process diagram is shown in Section 8.0 of the QAPjP.

10.10 INSPECTION

Procured materials that have the potential to impact the quality of data shall be inspected in accordance with the requirements specified in Section 10.0 of the QAPjP.

10.11 TEST CONTROL

Test control requirements specified in Section 11.0 of the QAPjP are not applicable to any of the RFI/RI investigations described in the OU15 WP.

10.12 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

10.12.1 Field Equipment

The Phase I radiological surveys will be conducted using a high-purity germanium detector. Smear counts will be made using an Eberline SAC-4 Alpha-Scintillation Smear Counting Instrument and a Eberline BC-4 Beta Smear Counting Instrument. Use, calibration, and maintenance of these instruments will be according to manufacturer's instructions.

Each piece of field equipment shall have a file that contains:

- Specific model and instrument serial number
- Operating instructions
- Routine preventative maintenance procedures, including a list of critical spare parts to be provided or available in the field
- Calibration methods, frequency, and description of the calibration solutions
- Standardization procedures (traceability to nationally recognized standards).

10.12.2 Laboratory Equipment

Laboratory analyses will be performed by contracted laboratories. The equipment used to analyze environmental samples shall be calibrated, maintained, and controlled in accordance with the requirements contained in the specific analytical protocols used as specified in the GRRASP. This information will be supplied to EG&G as a laboratory SOP.

10.13 HANDLING, STORAGE, AND SHIPPING

Samples shall be packaged, transported, and stored in accordance with OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Maximum sample holding times, sample preservative, sample volumes, and sample containers were specified in Tables 7-3 and 7-4. Those requirements are generally consistent with the sample holding time, preservative, and sample container requirements specified in Table 8-1 of Section 8.0 of the QAPjP. Sample handling and storage controls at the laboratory shall be provided as a laboratory SOP.

10.14 STATUS OF INSPECTION, TEST, AND OPERATIONS

The requirements for the identification of inspection, test, and operating status as specified in Section 14.0 of the QAPjP are not applicable to OU15 Phase I investigations.

10.15 CONTROL OF NONCONFORMANCES

The requirements for the identification, control, evaluation, and disposition of nonconforming items, samples, and data will be implemented as specified in Section 15.0 of the QAPjP. Nonconformances identified by the implementing contractor shall be submitted to EG&G for processing as outlined in the QAPjP.

10.16 CORRECTIVE ACTION

The requirements for the identification, documentation, and verification of corrective actions for conditions adverse to quality will be implemented as outlined in Section 16.0 of the QAPjP. Conditions adverse to quality identified by the implementing contractor shall be documented and submitted to EG&G for processing as outlined in the QAPjP.

10.17 QUALITY ASSURANCE RECORDS

QA records will be controlled in accordance with OPS-FO.02, Field Document Control. QA records to be generated during OU15 RFI/RI activities include, but are not limited to:

- Field Logs and Data Record Forms
- Calibration Records
- Sample Collection and Chain-of-Custody Records
- Laboratory Sample Data Packages
- Work Plan/Field Sampling Plan/QAA
- QAPjP
- Audit/Surveillance/Inspection Reports
- Nonconformance Reports
- Corrective Action Documentation
- Data Validation Results
- Data Reports

- Procurement/Contracting Documentation
- Training/Qualification Records
- Visual Inspection Records

10.18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified in Section 18.0 of the QAPjP. EG&G will conduct audits of the laboratory contractor as specified in the GRRASP, Parts A and B. The EMD QAPM shall develop a surveillance schedule with the surveillance intervals based on the importance and complexity of each sampling/analytical activity. Intervals will also be based on the schedule contained in Section 8.0.

Examples of some specific tasks that will be monitored by the surveillance program are as follows:

- Field sampling (approximately 5 percent of each type of sample collected)
- Records management (a surveillance will be conducted once at the initiation of OU15 activities, and monthly thereafter)
- Data verification, validation, and reporting

Audits of contractors providing field investigation, construction, and analytical support services shall be performed at least annually or once during the life of the project, whichever is more frequent.

A Readiness Review shall be conducted by the EMD QAPM prior to the implementation of OU15 field investigation activities. The readiness review will determine if all activity prerequisites that are applicable to begin work have been met. The applicable requirements of the QAPjP and this QAA will be addressed during the readiness review.

10.19 SOFTWARE CONTROL

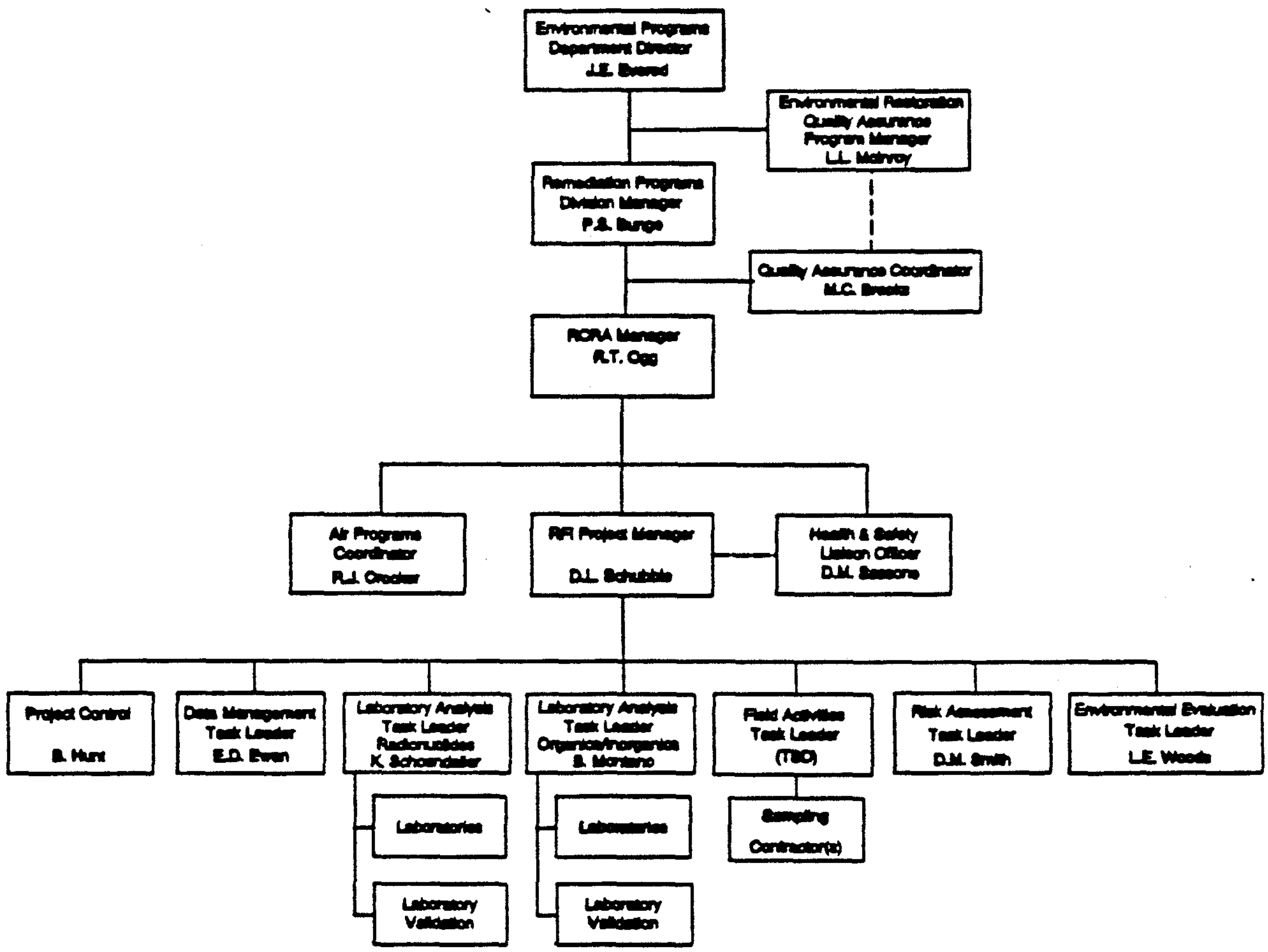
The requirements for the control of software shall be implemented as specified in Section 19.0 of the QAPjP. Only database software is anticipated to be used for the OU15 WP activities. Operating procedures applicable to the use of the database storing environmental data can be found in OPS-FO.14, Field Data Management.

TABLE 10.1
EMD Operating Procedures and Field Activities for Which They are Applicable

EMAD OPS Reference Number	Standard Operating Procedures	Bottle Sampling	Soil Sampling	Drum Sampling	Wipe Samples	Radiological Surveys	Visual Inspections
FO.02	Field Document Control	●	●	●	●	●	●
FO.03	General Equipment Decontamination	●	●	●	●	●	
FO.06	Handling of Personal Protective Equipment	●	●	●	●	●	●
FO.07	Handling of Decontamination Water & Wash Water	●	●	●	●	●	
FO.09	Handling of Residual Samples	●	●	●	●		
FO.11	Field Communications	●	●	●	●	●	●
FO.13	Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples	●	●	●	●		
FO.14	Field Data Management	●	●	●	●	●	●
FO.15	Use of PIDs and FIDs	●	●	●	●		
FO.16	Field Radiological Measurements	●	●	●	●	●	
FO.18	Environmental Sample Radioactivity Content Screening	●	●	●	●		
*EMRG 3.1	Performance of Surface Contamination Surveys					●	
Proposed	Drum Sampling			●			
SW.10	Surface Water Sampling	●					
Proposed	Surface Wipe Sampling	●			●		
Proposed	Soil Sampling		●				

* Environmental Management Radiation Guideline

FIGURE 10-1. PROJECT MANAGEMENT FOR OPERABLE UNIT NO. 15
INSIDE BUILDING CLOSURES



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Approved by:

____________________ __/__/__ ____________________ __/__/__

Manager, Remediation Programs | RFI Project Manager

11.0 STANDARD OPERATING PROCEDURES AND ADDENDA

The following EMD program-wide OPs will be utilized during the specific field investigations for OU15:

- FO.2 Field Document Control
- FO.6 Handling of Personal Protective Equipment
- FO.10 Receiving, Labeling, and Handling Environmental Materials Containers
- FO.13 Containerizing, Preserving, Handling, and Shipping Soil and Water Samples
- FO.14 Field Data Management
- FO.16 Field Radiological Measurements
- SW.10 Event-Related Surface Water Sampling

Specific information regarding most sampling activities is provided in the FSP (Section 7.0). Project-specific details for this Work Plan will be included in DCNs or OP revisions. These revisions will be attached to the OP for use during field activities. DCNs, OP revisions, and newly developed OPs will be available for review prior to issuing the Final Phase I RFI/RI Work Plan.

Approved by:

______________________ ___/___/___ ______________________ ___/___/___

Manager, Remediation Programs | RFI Project Manager

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APPENDIX A

Building Floor Plans

Showing IHSS Locations

Figures A-1, A-3, A-5, and A-6 contain unclassified controlled nuclear information (UCNI) and are not included in this document.

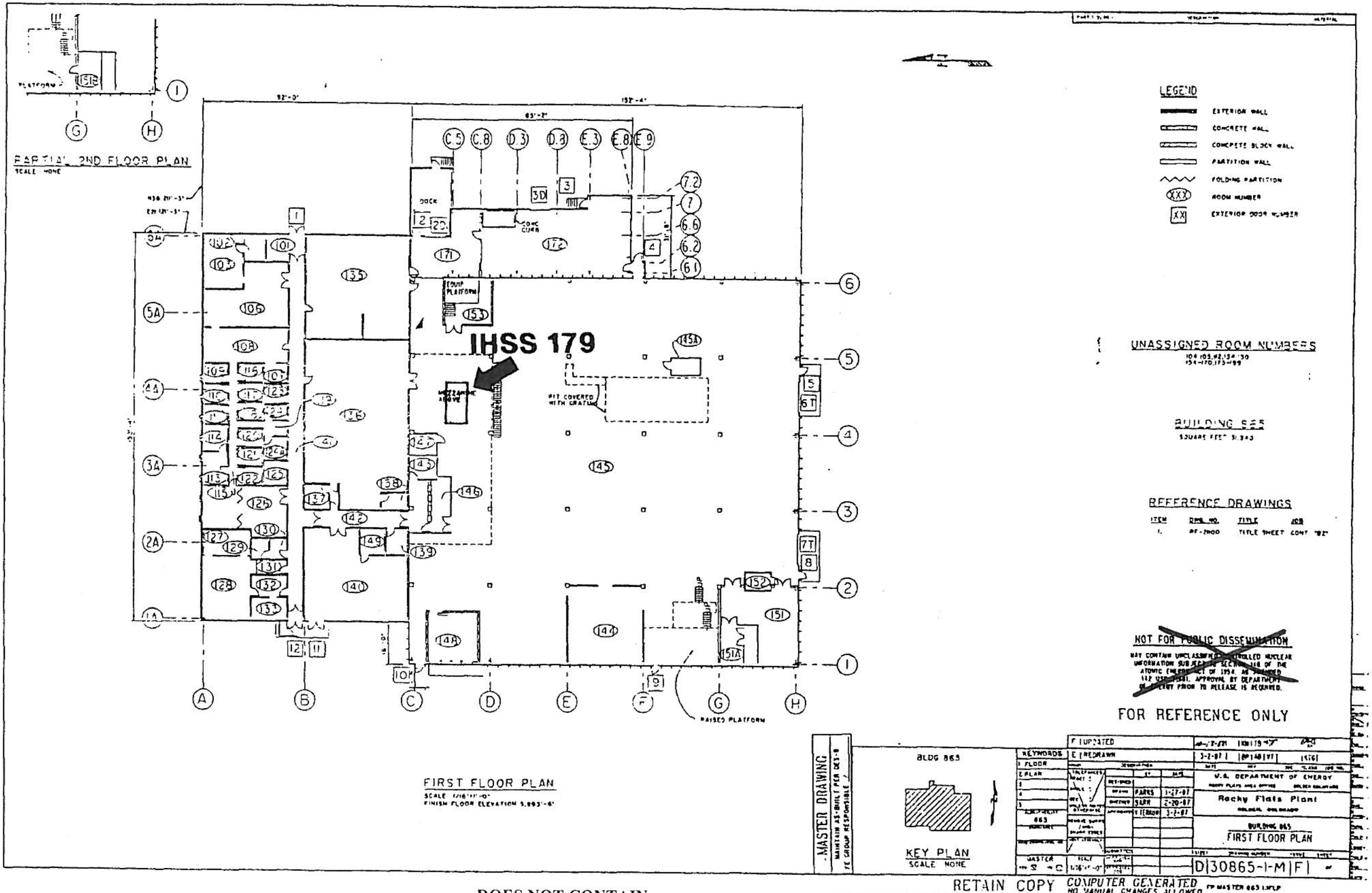
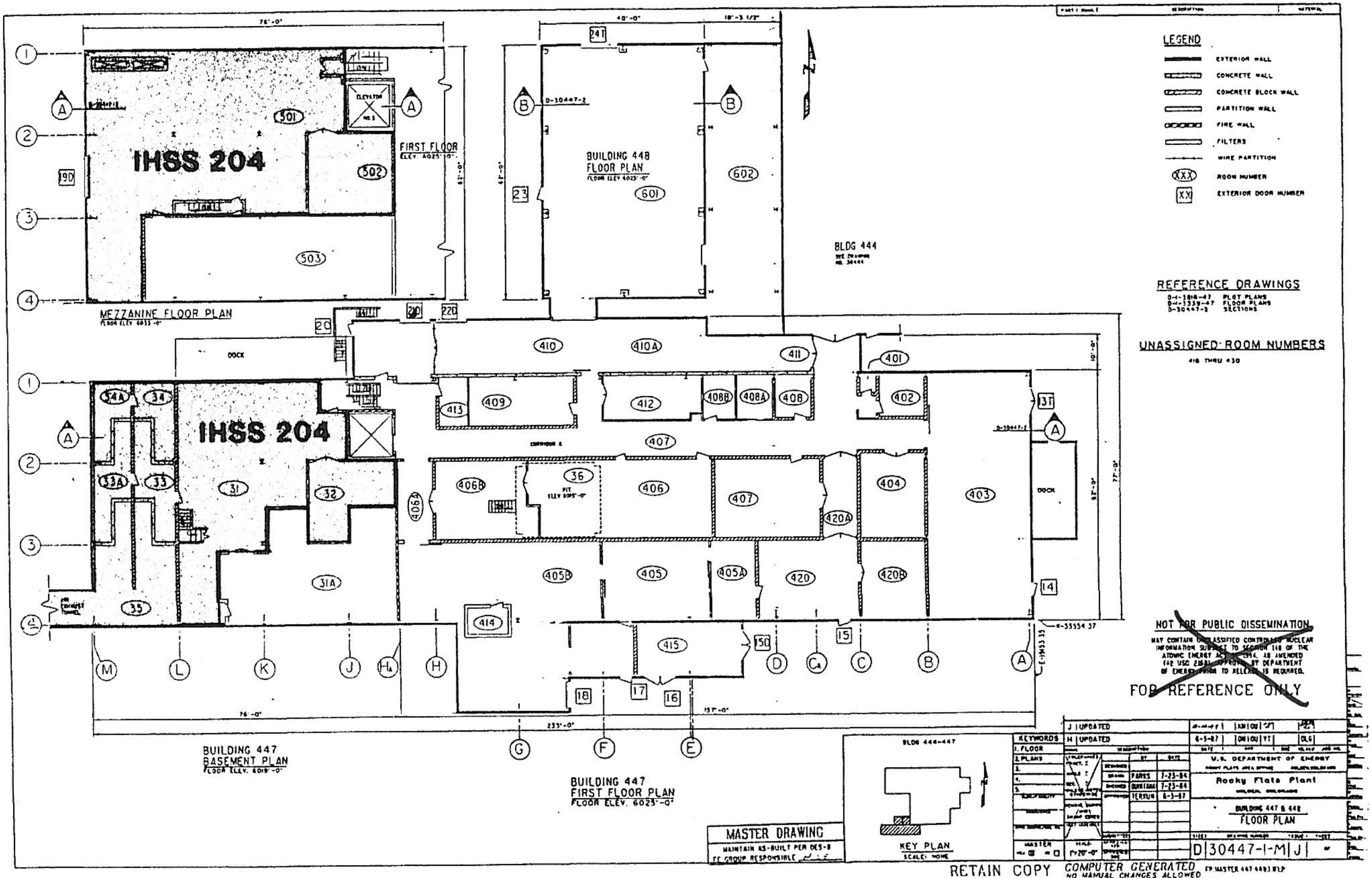


Figure A-2 Building 865 first floor plan

IHSS 179

DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
Reviewing JA Nesheem
Official: EMCBC Classin Office
Date: 10-27-08



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UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
Reviewing
Official: EMCBC Classification
Date: 10-27-08

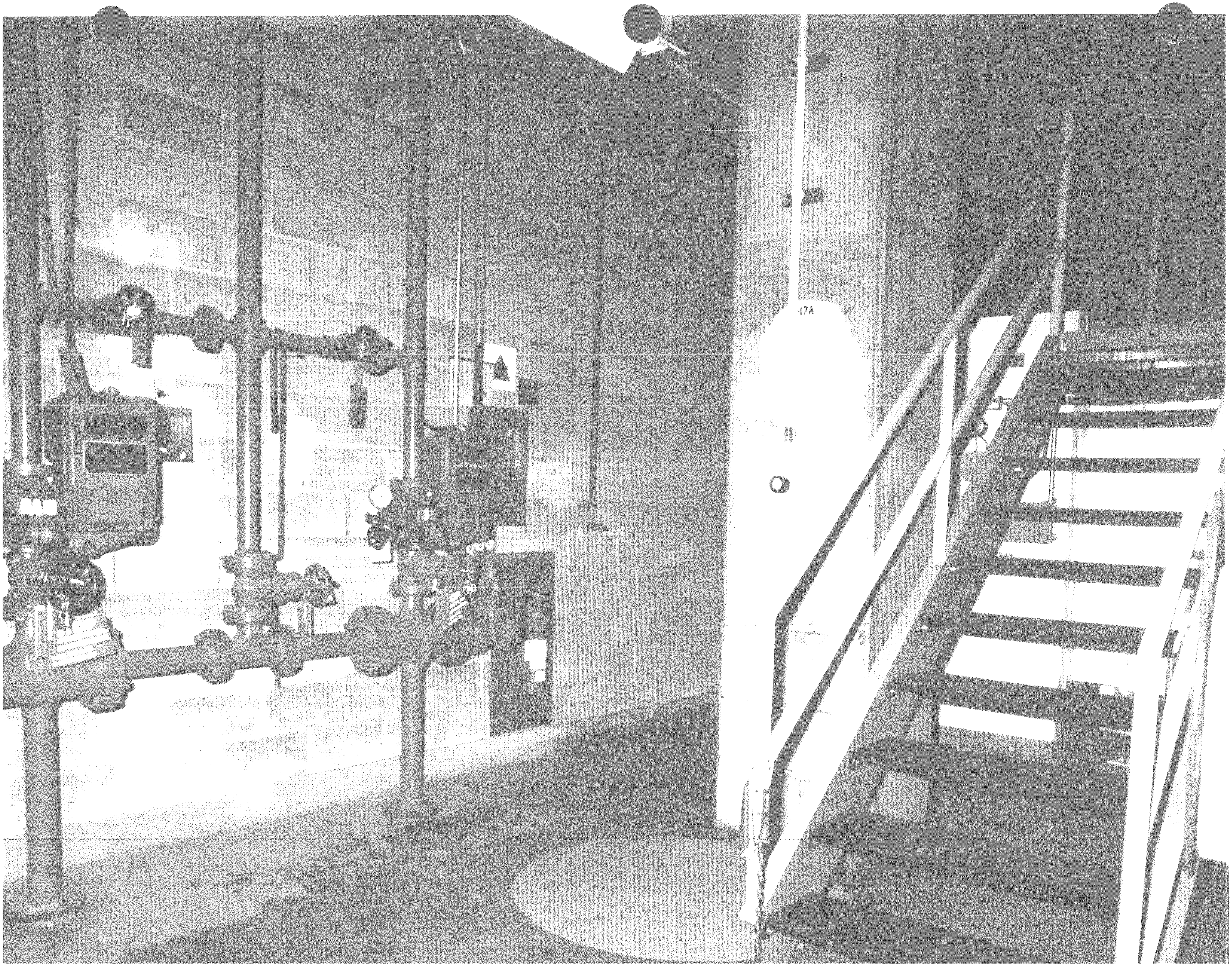
Figure A-4 Building 447 & 448 floor plan

IHSS 204

APPENDIX B

IHSS Photographs Showing Current Conditions,

April 1992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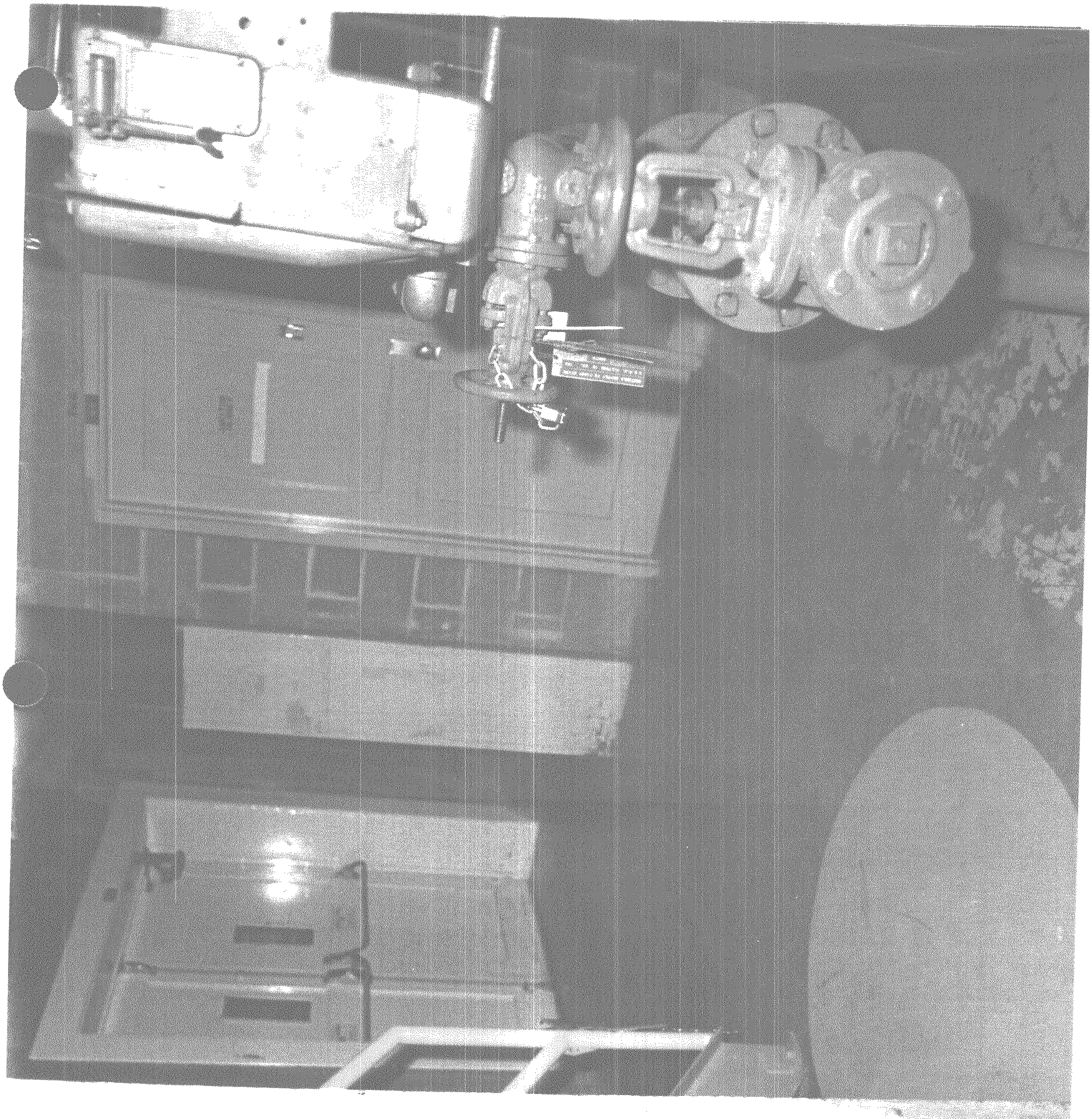
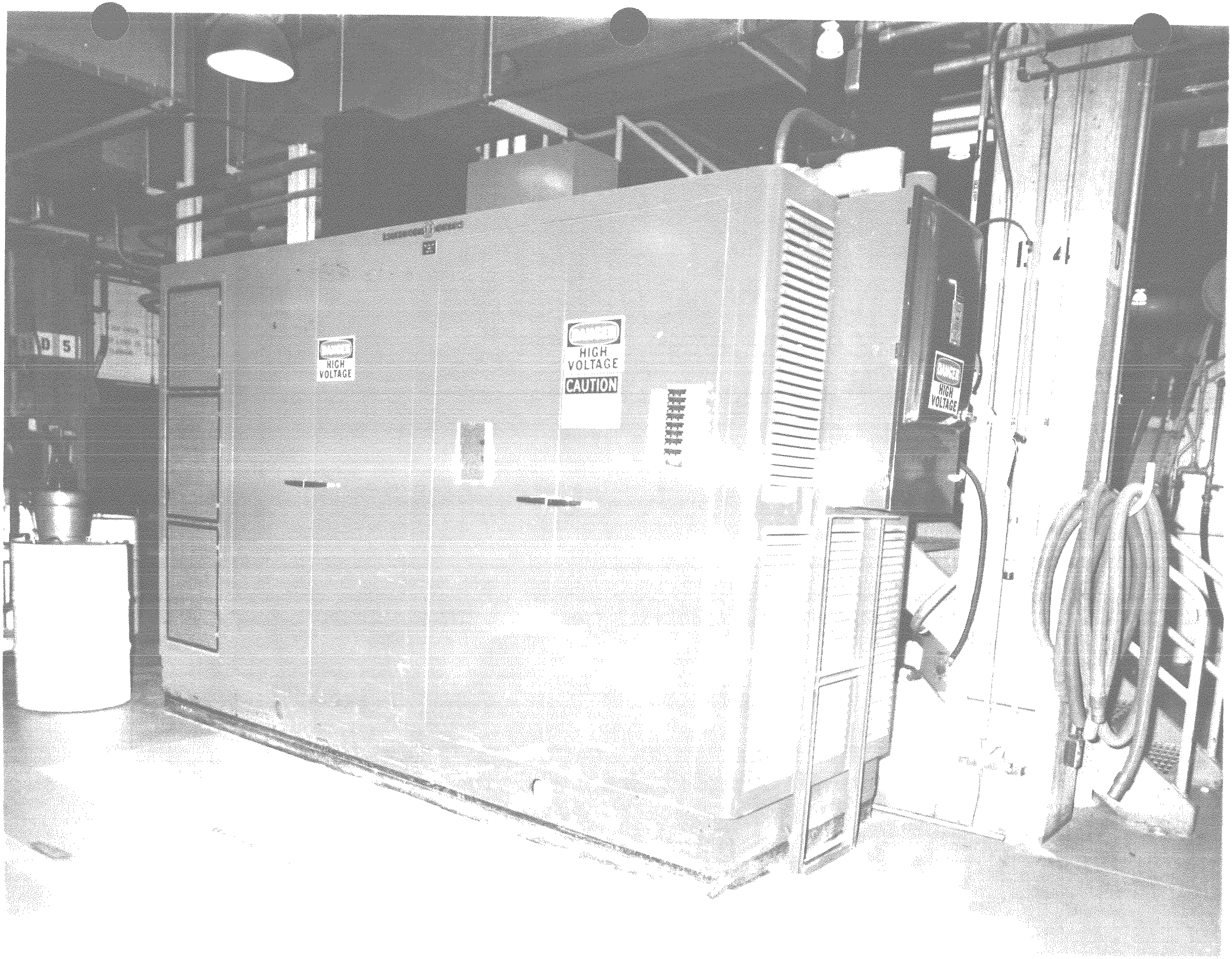
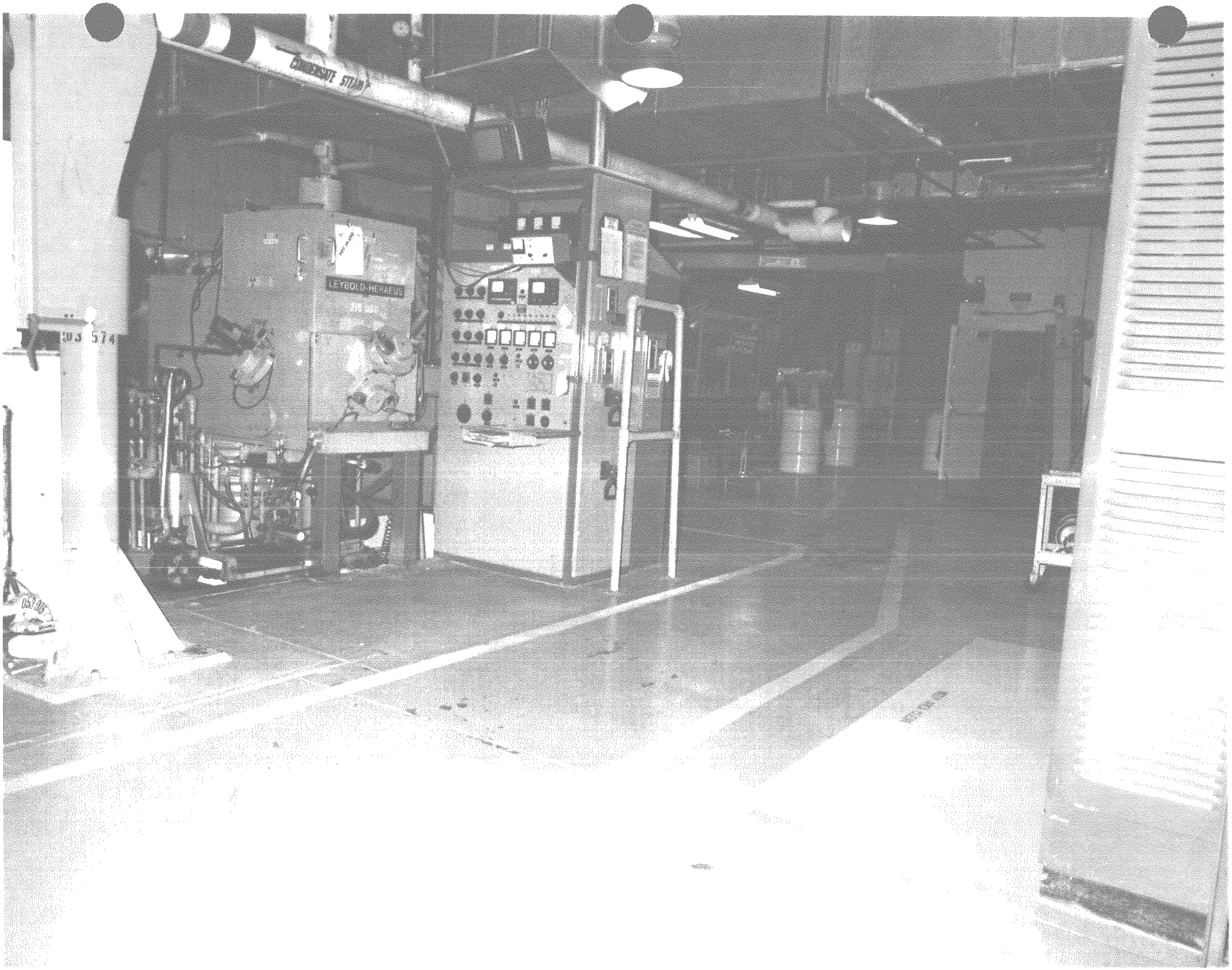
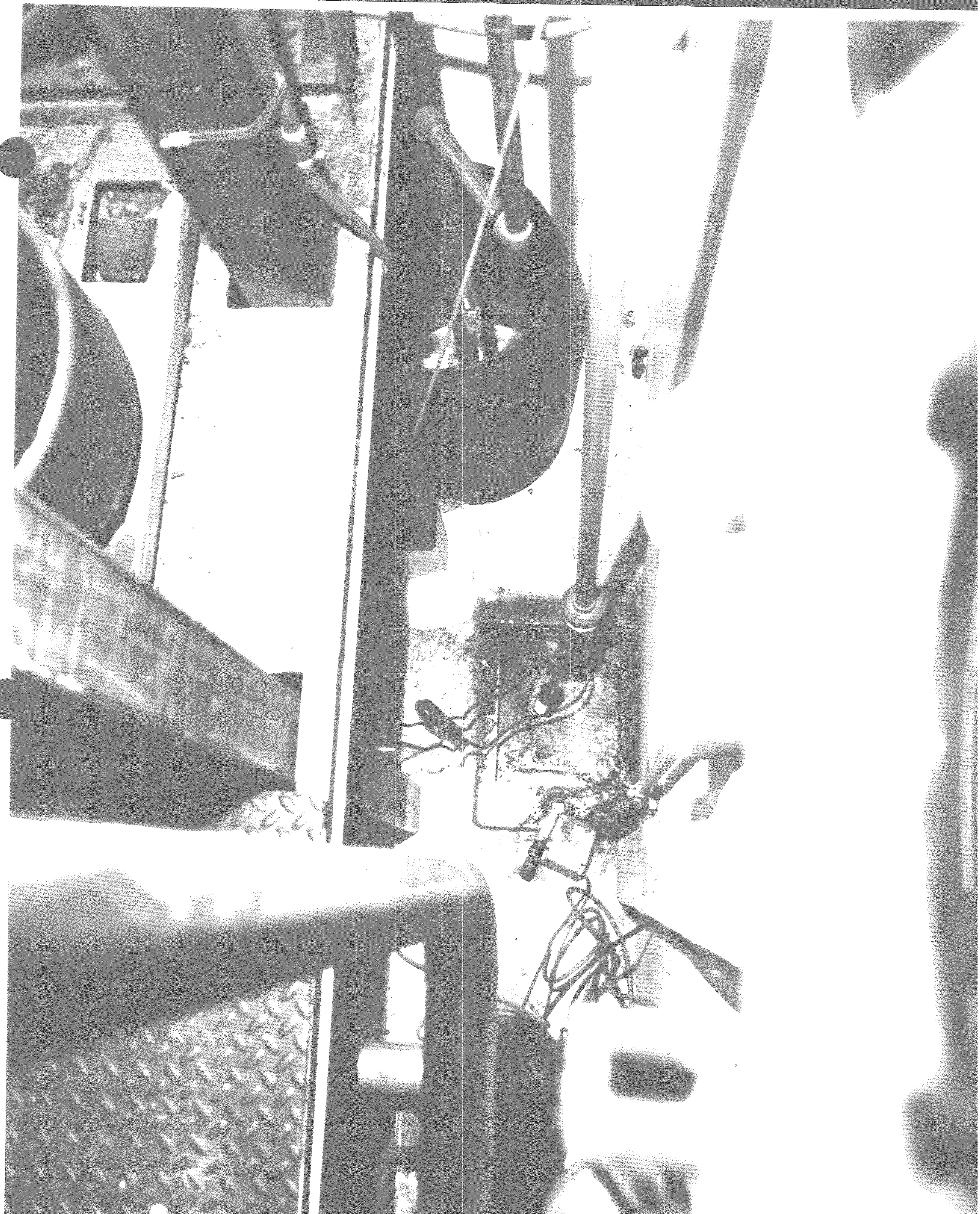
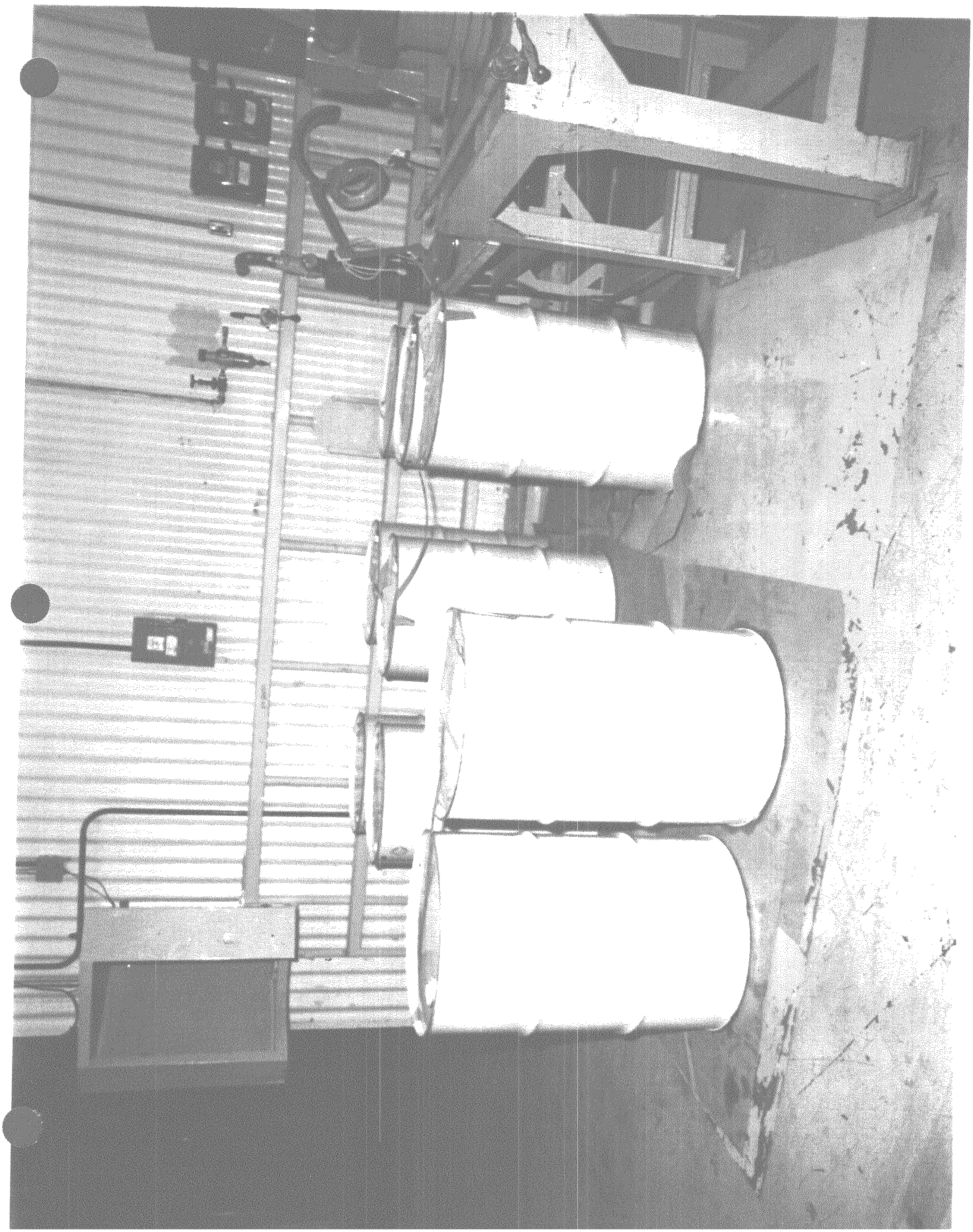


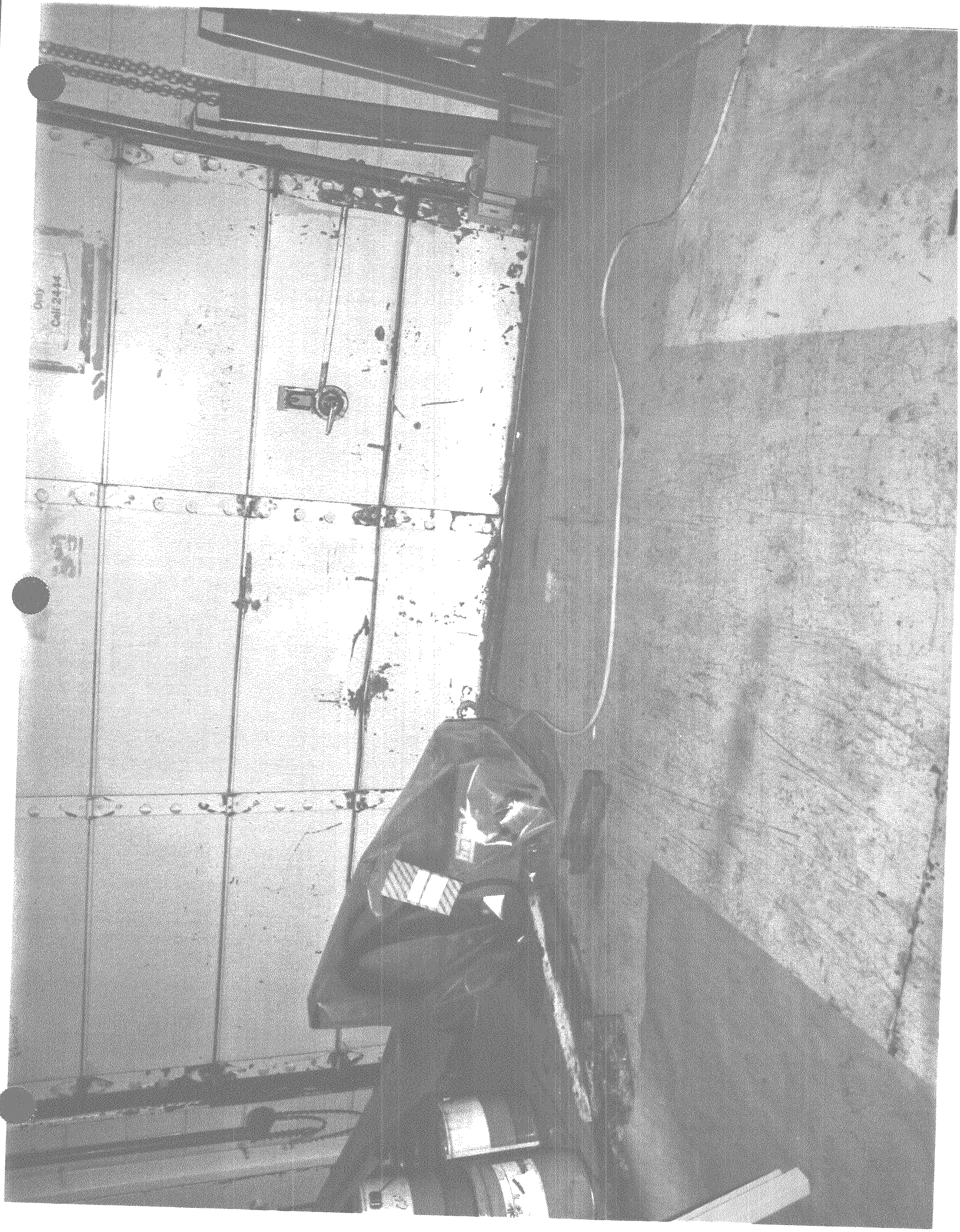

HIGH
VOLTAGE
HIGH
VOLTAGE
CAUTION
HIGH
VOLTAGE



CONDENSATE STEAM
LEYBOLD-HERAEUS






Only
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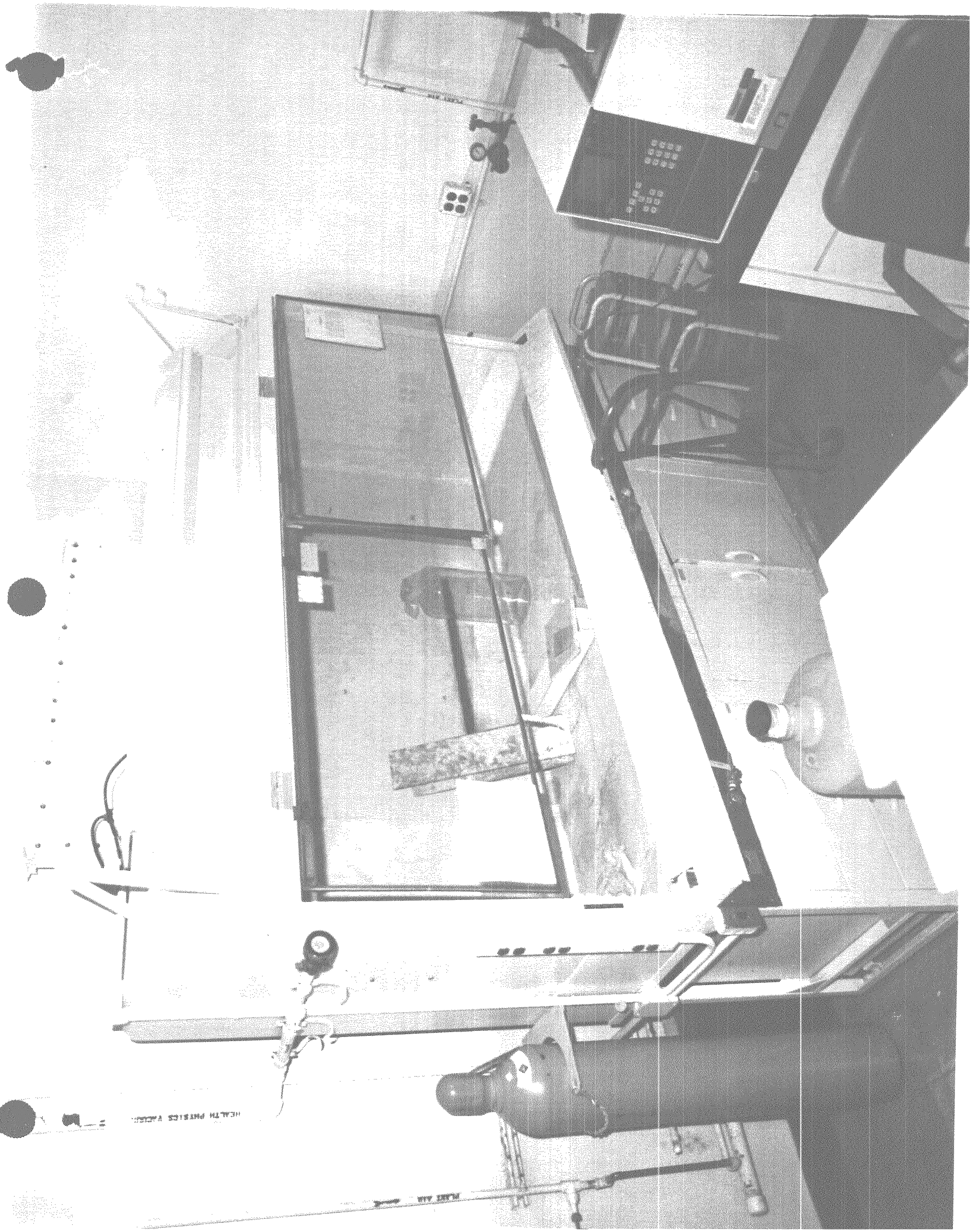
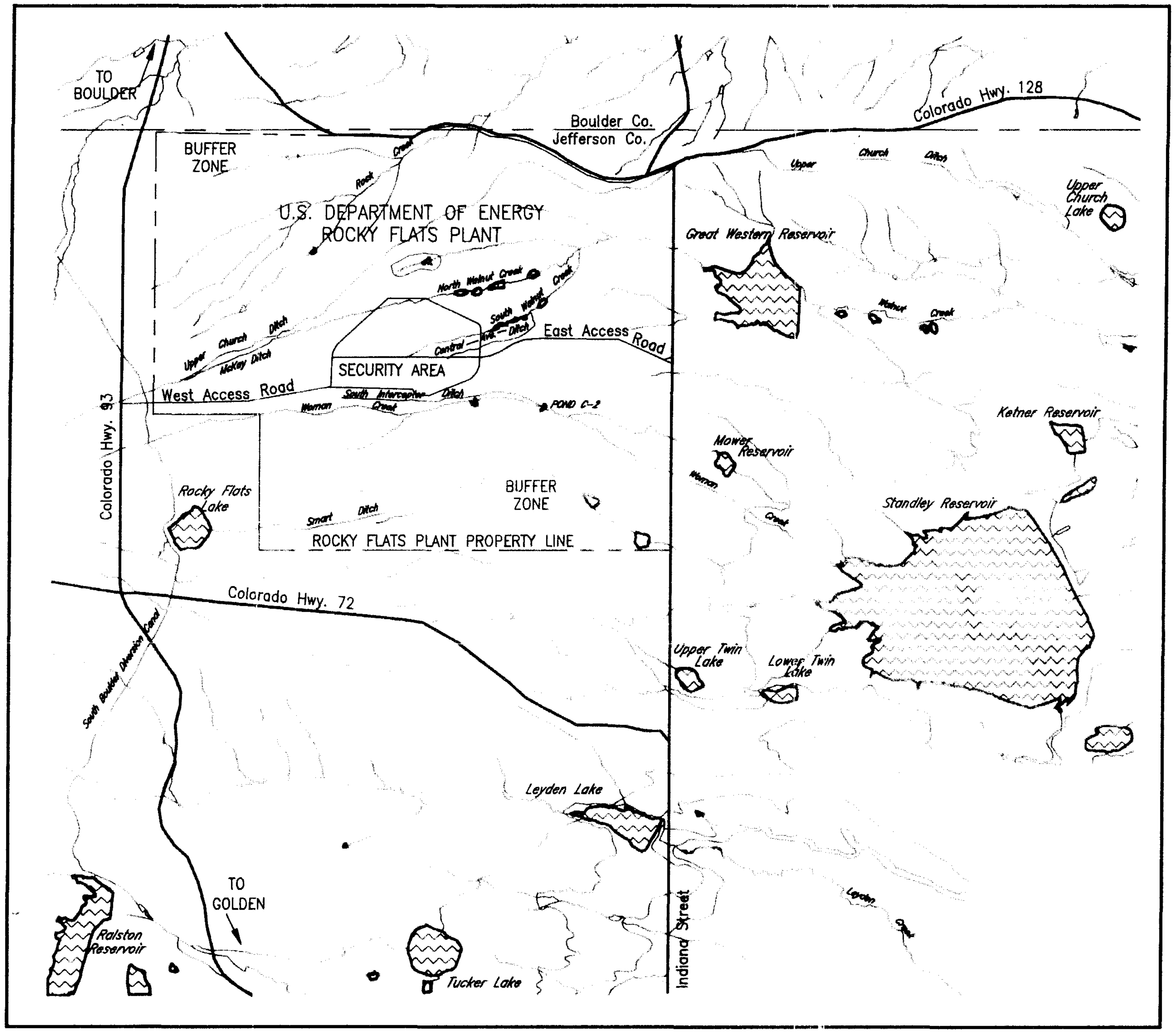
HAZARDOUS
WASTE
90-DAY
ACCUMULATION
AREA





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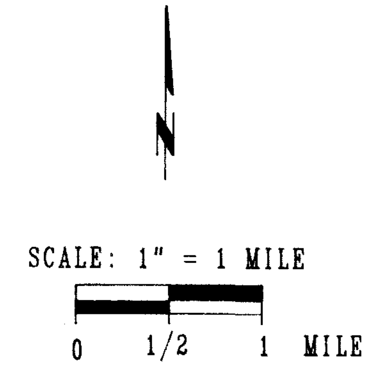
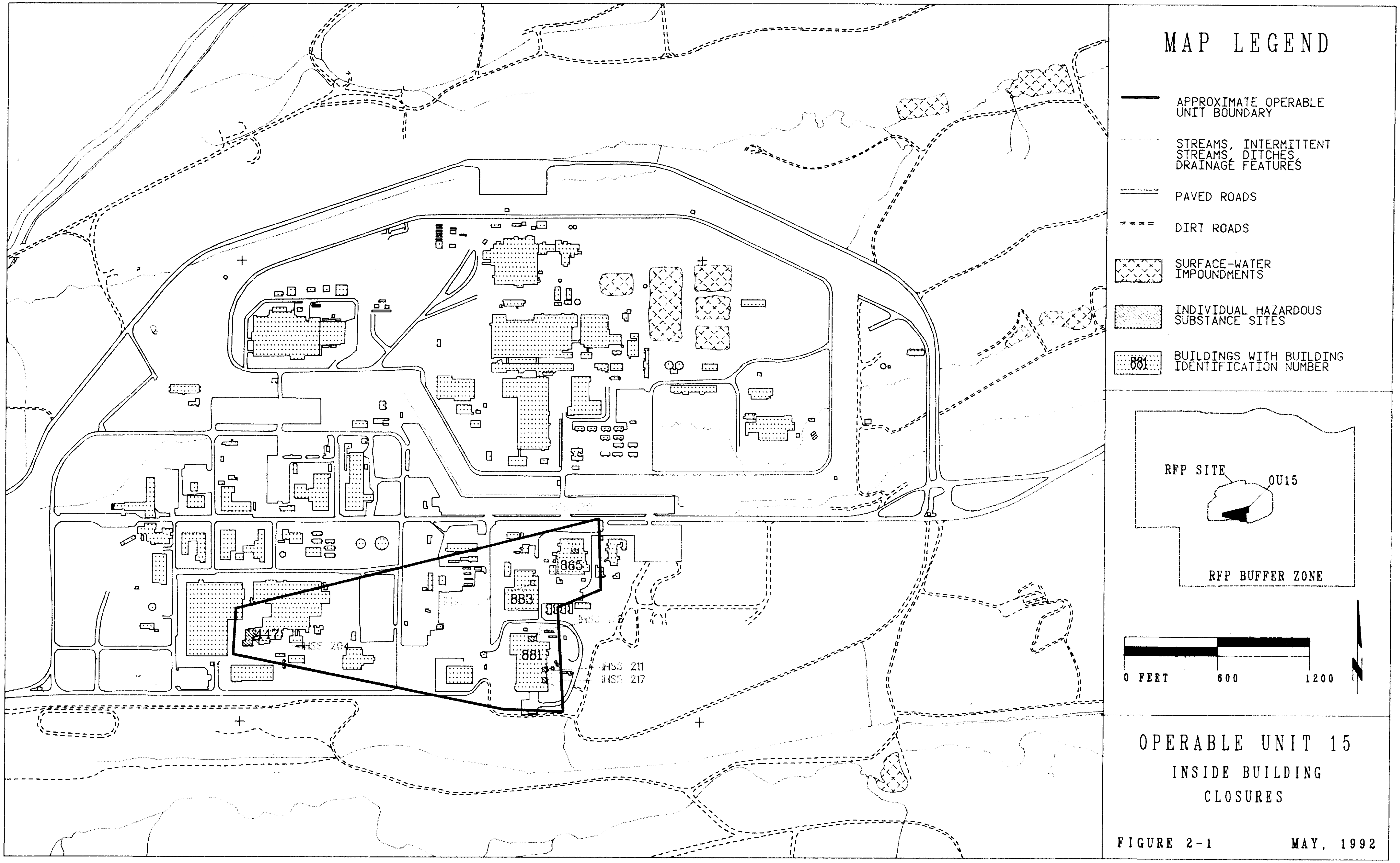


U.S. DEPARTMENT of ENERGY
Rocky Flats Plant, Golden, Colorado

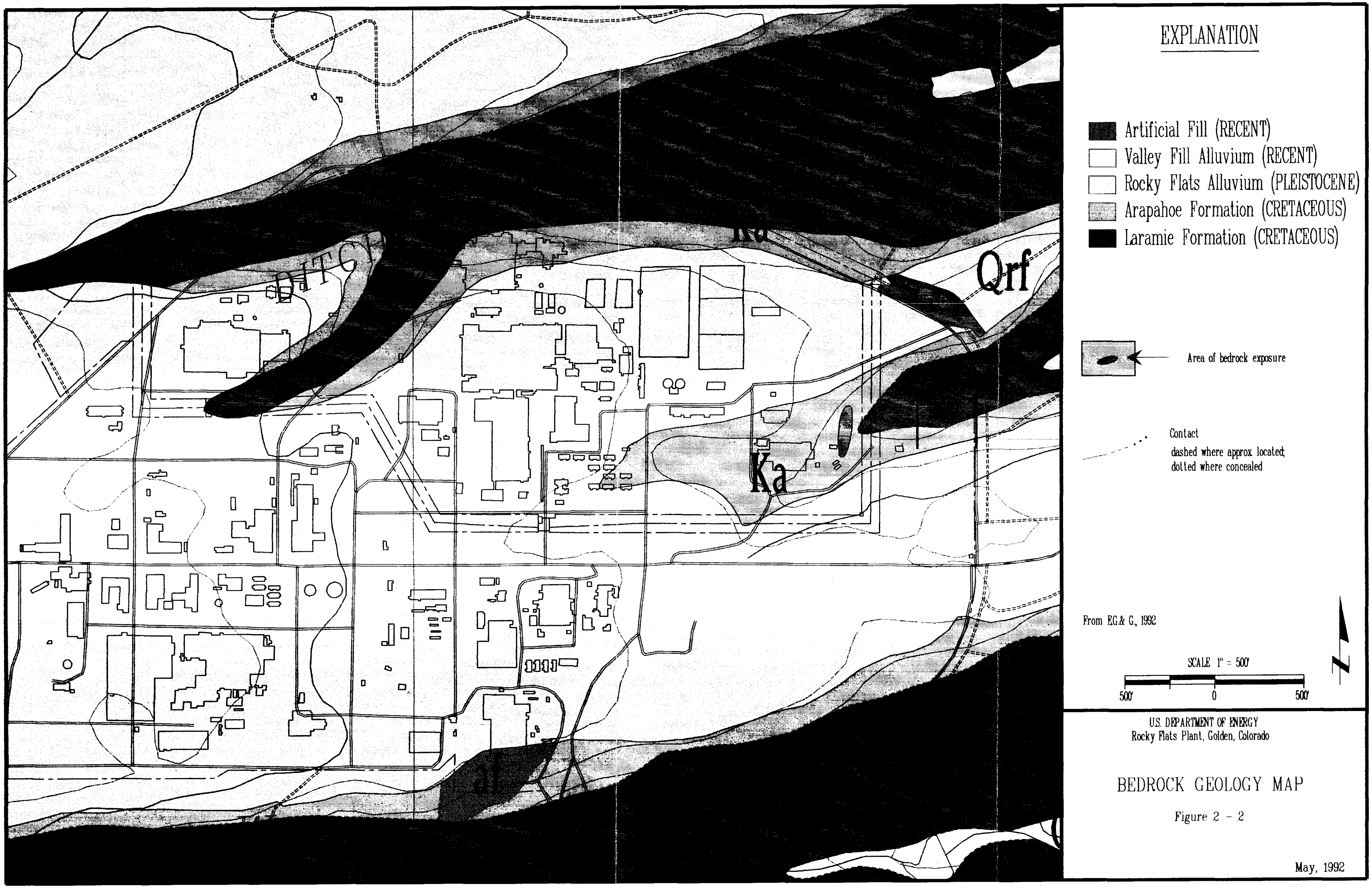
Location Map of Rocky Flats Plant and Vicinity

Figure 1-1



OPERABLE UNIT 15
INSIDE BUILDING
CLOSURES

FIGURE 2-1 MAY, 1992

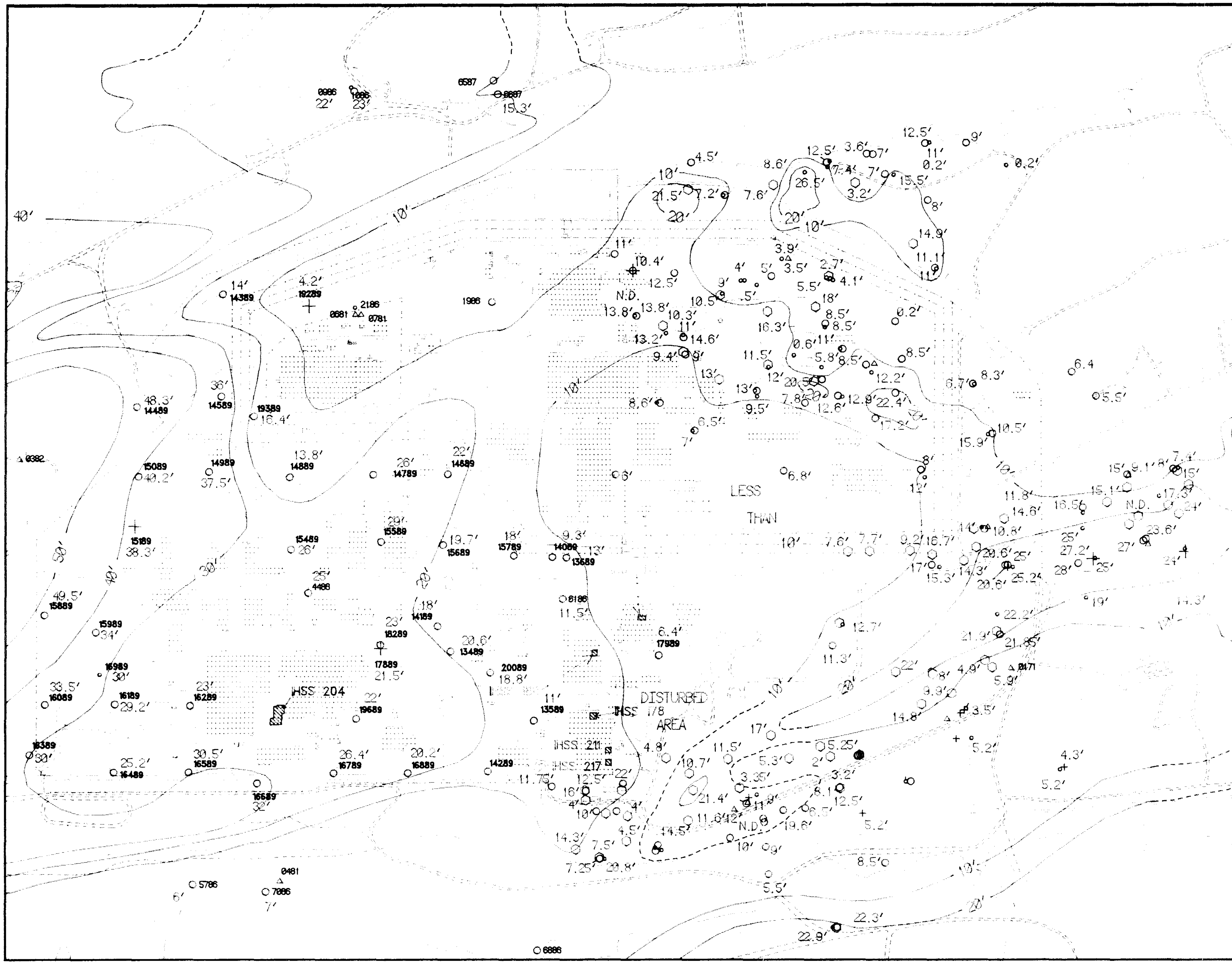


U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

BEDROCK GEOLOGY MAP

Figure 2 - 2

May, 1992



MAP LEGEND

ALLUVIUM ISOPACH
CONTOUR INTERVAL = 10ft.
DASHED WHERE APPROXIMATE

OU15 IHSS BOUNDARIES

PAVED ROADS

DIRT ROADS

STREAMS, INTERMITTENT STREAMS, DITCHES, DRAINAGE FEATURES

SECURITY FENCE

BUILDINGS

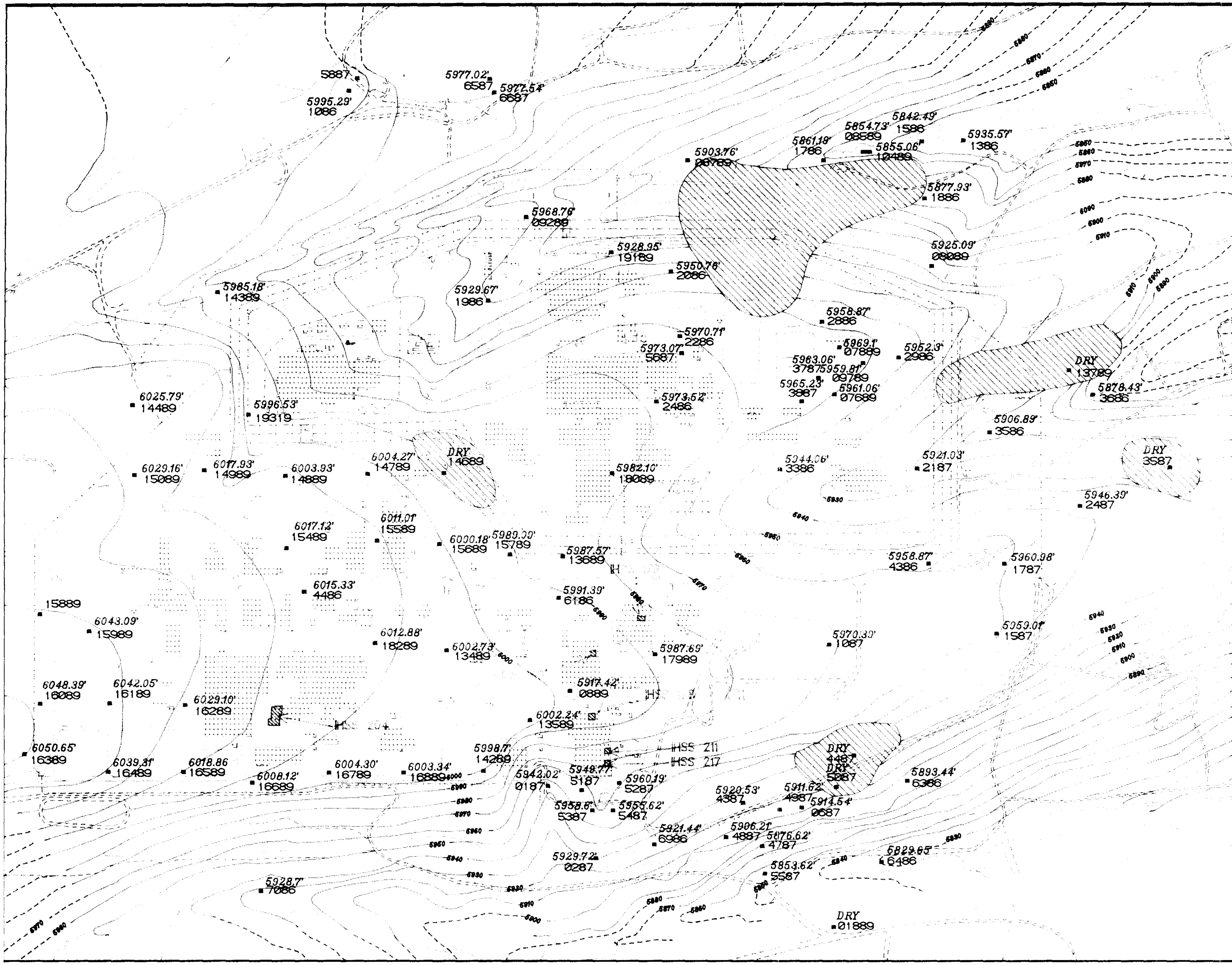
ALLUVIAL MONITORING WELL

ABANDONED BOREHOLE/WELLS

BOREHOLE

ROCKY FLATS PLANT
SURFICIAL DEPOSITS
ISOPACH MAP

FIGURE 2-3 MAY, 1992



MAP LEGEND

5906.89'
1386 — MONITORING WELL WITH WATER TABLE ELEVATION AND WELL IDENTIFICATION NUMBER

WATER TABLE CONTOUR (DASHED WHERE INFERRED)

OU15 IHSS BOUNDARIES

PAVED ROADS

DIRT ROADS

STREAMS, INTERMITTENT STREAMS, DITCHES, DRAINAGE FEATURES

SECURITY FENCE

UNSATURATED MATERIAL

BUILDINGS

ROCKY FLATS PLANT
POTENTIOMETRIC SURFACE MAP
UPPERMOST AQUIFER

FIGURE 2-4 MAY, 1992